

Ethernet Tutorial & Product Guide

May - July 1996

New In This Issue:

- ▼ Remote Access Servers
- ▼ Print Servers
- ▼ RMON Probes



- ▼ Remote Access Servers
- ▼ Print Servers
- ▼ RMON Probes
- ▼ Network Analyzers
- ▼ Terminal/Printer Servers
- ▼ Switches/Bridges
- ▼ Repeaters/Hubs
- ▼ Transceivers

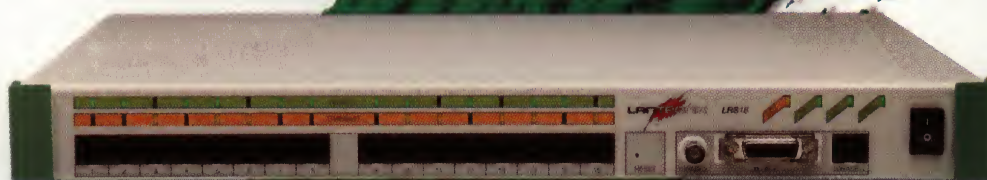
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- ▼ Routes IP and IPX Over Dial-Up Lines
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15353 Barranca Parkway
Irvine CA 92718
714/453-3990 Fax: 714/453-3995
sales@lantronix.com
International Sales: 714/450-7227
intsales@lantronix.com
World Wide Web: <http://www.lantronix.com>



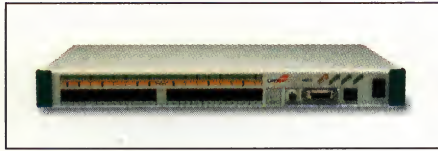
Network Analyzers ▼ Remote Access Servers ▼ Terminal/Printer Servers ▼ Print Servers ▼ Bridges ▼ Switches ▼ Repeater/Hubs ▼ Port Multiplier ▼ Multipoint Transceivers ▼ Transceivers/Converters ▼ Micro Serial Servers

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What's New

LRS16 Remote Access Server

The LRS16 is a 16-port remote access server for remote node, remote control, LAN-to-LAN, modem pooling and Internet access applications. The LRS16 routes IP and IPX protocols and acts as a firewall. All 16 serial ports support simultaneous 115.2 Kbps data transmission along with bandwidth on demand for improved performance. With one of the lowest prices per port in the industry, the LRS16 features tiered security features including encrypted passwords, dial back and multilevel password access. It supports PPP and SLIP/CSLIP for interoperability. See page 3.



NDS support for EPS2/EPS1, MPS1 Print Servers

The Lantronix EPS2, EPS1 and MPS1 support the most popular networking protocols, including IPX, TCP/IP, AppleTalk, NetBIOS/NetBEUI and LAT. Now, Lantronix has made support of Novell's NetWare Directory Services available on all of these products free of charge. Each print server has Flash ROM for easy upgrades of software. Print server: installation is quick and easy with EZCon graphical configuration software for Windows, UNIX and Macintosh. See page 6.



LRP6/LRP2 RMON Probes

The LRP6/LRP2 are multiport RMON probes with full SNMP and RMON support. The LRP family offers an affordable price and advanced functionality. The products include EZMon, a GUI-based snap-in application for HP OpenView for Windows for easy configuration, in-depth information management reporting and menu driven in-band and out-of-band management. The LRP6/LRP2 have powerful analysis tools, including triggers for "Roving RMON". See page 9

LFR8 Fast Ethernet Hub

The LFR8 is an eight-port, Class II Fast Ethernet repeater that offers not only an attractive price per port, but also a low overall unit price. The LFR8 is designed as a backbone for Ethernet switches, server farms, and bandwidth-hungry users, and can operate in rack-mount or table-top applications. The universal power supply and a full set of diagnostic LEDs complete a flexible yet powerful feature set. See page 19.

To Our Customers

Everywhere you look these days, it seems like the issue of managing networks is at the forefront. In reading the trade publications and talking to customers, I've seen it over and over. With increasing network complexity comes a desire to improve network management and make network devices easy to use.

We at Lantronix have heard this message and are attacking the problem in two ways; reexamining our mainstream product line to make sure we've built in ease of use, and launching new products to help simplify the job of managing the network.

Lantronix products are built with ease of use in mind. The print server products, for example, can be installed in three simple steps.

We've improved on that lately with EZCon; a graphical configuration and management program that makes it easy to configure all of the "power-user" features that are built into the product.

EZCon is also extended to our larger server family and runs in UNIX, Macintosh and Windows environments. A variety of GUI interface packages are now shipping with all other software intensive products, including terminal servers, remote access servers and the MSS1 serial server.

On the new product front, Lantronix has taken aim at simplifying switched networks. We realize that switched networks solve a bandwidth problem by segmenting networks. However, now you have many networks to manage, where before there was just one. With our new families of RMON probes and network protocol analyzers, I think you'll see we've developed some innovative tools for solving this problem.

With both of these products, we've taken a product idea that, until now, has been expensive and available only in single port versions. To meet the new demands of the network, the Lantronix version of these devices offers several ports for monitoring multiple segments simultaneously. And, in true Lantronix fashion, we've priced these devices very competitively.

Finally, we've made it easy to buy all of these products. All the information is right here at your fingertips! Take a look.

Sincerely,

Brad Freeburg
President

Ethernet Tutorial and Product Guide

Lantronix is a rapidly growing company which sells over half of its products outside the U.S.A. through an expanding network of quality international partners. Please contact your distributor or reseller about product pricing information, product availability, configuration questions, or warranty and technical support issues. They can also provide you with information about new additions to the Lantronix product line as that information becomes available.

Warranty and Repair

Lantronix products have a limited warranty up to five years. If you experience any technical difficulties or have configuration problems, please call Technical Support or contact us via the Internet. A variety of free support options are available — call for more information.

Technical Support Fax: 714/450-7226

Technical Support: 714/453-3990

Internet: support@lantronix.com

FREE On-Line Software Upgrades!

Lantronix provides the latest software through the Internet via Anonymous FTP (ftp.lantronix.com) or via dial-up downloading on the Lantronix Bulletin Board Service at 714/367-1051.

Ordering/Information

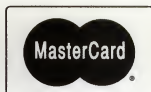
If you don't know who the local reseller or distributor in your country is, contact the international sales department at:

International Fax: 714/450-7231

International Telephone: 714/450-7227

International Internet: intsales@lantronix.com

World Wide Web: http://www.lantronix.com



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Remote Access Servers



In the 1990s, the concept of "connectivity" has been raised to new heights. E-mail within a company allows instant communication between all levels of the organization. The use of the Internet enables increased contact for both individuals and corporations alike. And with notebook PCs, the mobile or telecommuting worker can easily maintain contact from distant locations.

Where previously only expensive dedicated leased lines were available to link remote networks, now any available telephone line has become a portal to the corporate network when Point to Point Protocol (PPP) is used. Where individual users dialing into an office network used to be limited to modem speeds of 9.6 Kbps or less, they now can call in at 28.8 Kbps. These advancements have led to a whole new class of devices called remote access servers that provide the means for the remote office and the remote user to stay in touch with the corporate network.

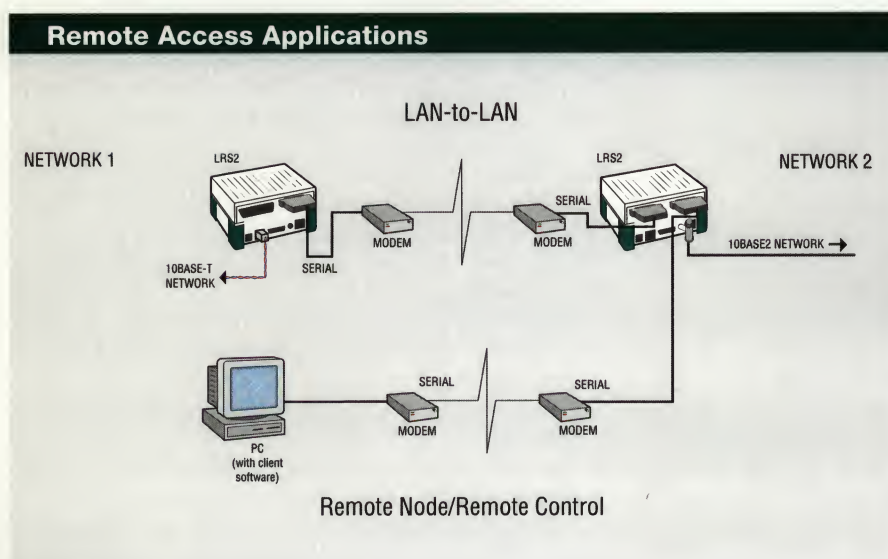
Remote access means different things depending on an organization's communication needs.

- ▼ Remote node, remote control applications are when a remote user on a PC or workstation dials into a network and is able to function as if he or she were directly attached to the network. A remote access server provides dial-in services and support for PPP to allow full functionality of the remote user as a network peer (remote node) or to allow the remote user to take over a local node (remote control).
- ▼ LAN-to-LAN is when an entire remote network is supported over a dial-up connection. Remote access servers on each end act as routers to automatically generate a connection when remote resources are requested. The dial-up connection is maintained according to parameters established by the network manager for timeouts, allowed protocols and for connection duration.

▼ Internet access applications involve the use of a remote access server as a router to "firewall" the local network from security problems present on the Internet. Filters are selected by the network manager to ensure that only authorized traffic is allowed to pass between the local network and the Internet. These applications are actually a hybrid form of LAN-to-LAN connections.

▼ Modem service is the ability of the remote access server to provide access for network users to a bank

Remote Access Applications



of modems for both dial-in and dial-out applications.

The Lantronix LRS Remote Access Servers

The Lantronix LRS family of multi-purpose remote access servers allows network managers to provide dial-up network services to their remote users. With the two models of the LRS family, Lantronix offers servers for both the central site and the remote branch office.

The LRS16's 16 serial ports offer full 115.2 Kbps PPP/SLIP throughput on each port simultaneously, allowing 16 modems running remote applications to operate at full speed at all times. Whether V.34 modems with 4:1 compression or ISDN Terminal Adapters are used, the LRS16 will support full speed remote node, LAN-to-LAN, Internet access or modem-service applications.

The LRS16 is capable of being used as a rackmount or standalone unit (hardware for both configurations included). Status LEDs provide data on the state of each serial line and the LRS16 itself.

The LRS2 is a two-port unit, designed to provide remote access services for the smaller remote office. The LRS2 enables a network at a branch office to connect to other networks via LAN-to-LAN dial-up or where remote access is required to a site-specific resource. The small profile of the LRS2 makes it easy to fit into the smaller office, and the low entry price is appropriate for small-office budgets. An LCD and four front-panel console buttons allow for easy access to status of the unit, a feature non-technical staff members will appreciate.

In a LAN-to-LAN application, IP and IPX protocol traffic on the network is monitored by an LRS and when a connection to resources on the remote network is required, the server automatically dials up and connects to that network. Once the network connection is established, the LRS will monitor the link according to criteria defined by the network manager and automatically maintain the link to those specifications. These parameters include: the amount of time the link is to remain connected if no data is being passed; whether the link is to remain connected if only certain types of traffic are present (i.e. disconnect if only the keep alive or broadcast messages are being transmitted); whether or not to allow a particular protocol or packet type to travel the link between the two networks. Additional convenience features are automatic re-dialing in case of a busy answering modem or an unplanned disconnect, and time-of-day limits for dial-in/dial-out operations.

The LRS family also supports Multilink PPP, a bandwidth-on-demand feature that can bring up extra links in LAN-to-LAN applications when more bandwidth is needed. Both the LRS16 and the LRS2 can be configured to trigger the bandwidth-on-demand feature when traffic levels on a link reach a specified level. This is convenient in a branch office application when one

user dials up the headquarters office and then multiple other users also use that headquarters link. As these new users impact the throughput on the link and generate a requirement for more bandwidth, a new connection is automatically brought up and the traffic is split between the two links.

An LRS also can be used to support dial-in and dial-out connections by users seeking remote node or remote control functionality. The remote node dial-in application is typically the individual remote user on a portable PC who requires status as a peer on the target network for reading or sending e-mail, or for downloading files. The remote control user seeks to gain control of a PC on the network for applications where the remote user does not have the data or the computing power to process the work at hand, such as a large database inquiry. Both LRS models support PPP and SLIP/CSLIP for IP users and PPP for IPX users. A client software package for remote node is included with each LRS2 (for a limited time) and is optional for the LRS16. For networks where there is already an established PPP client, the LRS is compatible with most products, including Windows95. For dial-out applications, the LRS products support modem sharing with a communication port redirector software package. This software is included with each LRS product and allows easy access to modems attached to the unit.

Simple Configuration

While some remote access products require the network manager to wade through large lists of commands, the LRS family greatly simplifies the configuration process with EZCon, a menu-driven GUI-based (graphical user interface) utility. EZCon ships with each LRS and runs on UNIX, Macintosh, Windows PCs with WinSock and Novell PC systems. Configuration menus guide the network manager through the installation procedure with point-and-click efficiency, allowing for speedy and easy setup. The LRS2 also has an LCD and front-panel keypad for manual diagnostics displays. Both products allow any serial port to be used for network management.

Security

The LRS family provides a number of ways for the user to ensure the data security in a dial-up environment. Password protection is available on four different levels:

1. PAP/CHAP support on PPP connections;
2. Kerberos and SecurID authentication schemes are supported;
3. Server passwords for authentication of the user attaching to an LRS;
4. System passwords as supported on Unix (passwd) and Novell (NetWare Bindery) hosts.

The LRS units are able to log all port activities to either memory or to log files to allow for inspection of

event sequences for suspicious activity. The devices also support dial back, a feature that allows the unit to authenticate a user and then dial that user back at the authorized location. Last but not least, the packet filtering capabilities of the LRS units allow the user to build firewalls to keep unwanted packet traffic from making its way onto the network over a dial-up connection.

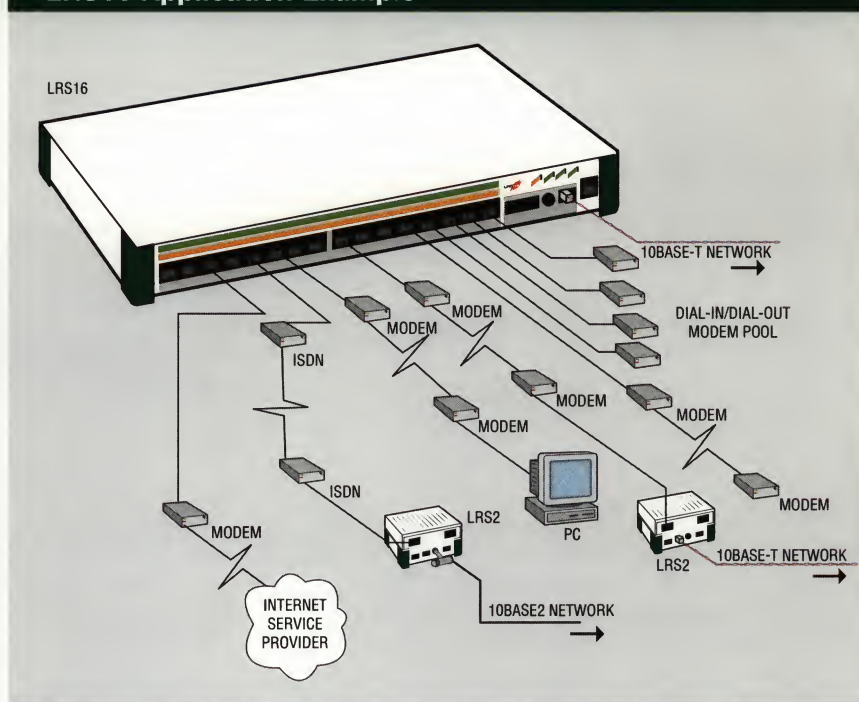
Other Applications

There are several other common network applications where the combined routing and communications services provided by an LRS can be useful. The routing capabilities of the LRS family make them ideal as a filtering device (firewall) between a network and a remote service provider. By selecting from the built-in filtering options, the network manager can build a custom filter to deny access for any unwanted traffic from the Internet. As a communications service device, the LRS units also offer modem pooling for IP/IPX applications and terminal and printer service for Unix and Novell NetWare hosts.

Product Features

The LRS16 and LRS2 are supported by Lantronix's free software upgrades over the Internet or via the

LRS16 Application Example



Lantronix BBS. Using Flash ROM, LRS devices are able to download new software from a network loadhost when desired; otherwise, the operating code resides in the unit itself and loads automatically on power up. Both the LRS16 and LRS2 come with a 5-year limited warranty and free technical support to ensure a lifetime of product satisfaction. They also feature easy to use, CD-ROM-based installation and reference guides.

Remote Access Servers

PART NO.	DESCRIPTION
LRS16	16-port remote access server, Flash ROM, 16 RJ45 RS423/RS232 interfaces, full modem control. 115 Kbps simultaneous performance on all 16 ports. AUI, RJ45 (10BASE-T) and BNC (10BASE2) Ethernet interfaces. Rackmount hardware, installation guide, CD-ROM containing EZCon GUI software and reference manual. Internal power supply. Status LEDs for each port. Serial console cable kit included.
LRS2-01	2-port remote access server, Flash ROM, 2 DB25 RS232/RS423 interfaces, full modem control. AUI, RJ45 (10BASE-T) and BNC (10BASE2) Ethernet interfaces. Installation guide, CD-ROM containing EZCon GUI software and reference manual. Remote node/remote control software included. 120VAC external power supply. Routes IP and IPX protocols over dial-up lines.
LRS2-02	Same as above with 220 VAC external power supply.
500-018	Modem Cable, female DB25 to female DB25, 6 ft. (LRS2 only).
500-019	Modem Cable, female DB25 to male DB25, 6 ft. (LRS2 only).
500-023	Cable kit for LRS16 consisting of 8 6-foot RJ45 cables, 8 prewired DB25 Modem connectors and 4 DB25 female connector kits.
F3-LRS16	Remote node software for LRS16; contains unlimited user license for 16 ports; includes trial version of remote control software.
F3-LRS2	Remote node software for LRS2; contains unlimited user license for 1 port; includes trial version of remote control software; one copy is included free in each LRS2.

Print Servers



Lantronix's print servers are devices that allow multiple users to share printers anywhere on an Ethernet network. The Lantronix MPS1 and EPS2/EPS1 print servers allow a variety of printers to be connected to a wide range of network protocols. The MPS1 Micro Print Server provides a single parallel connection, and the EPS2 and EPS1 print servers provide both serial and parallel port connections. Lantronix's print servers are capable of printing from hosts that run IPX (Novell NetWare), TCP/IP (Unix), AppleTalk (Macintosh/EtherTalk), NetBIOS/NetBEUI (LAN Manager/Windows NT) and LAT (DEC) protocols (a license is required to run the LAT protocol on the EPS2/EPS1).

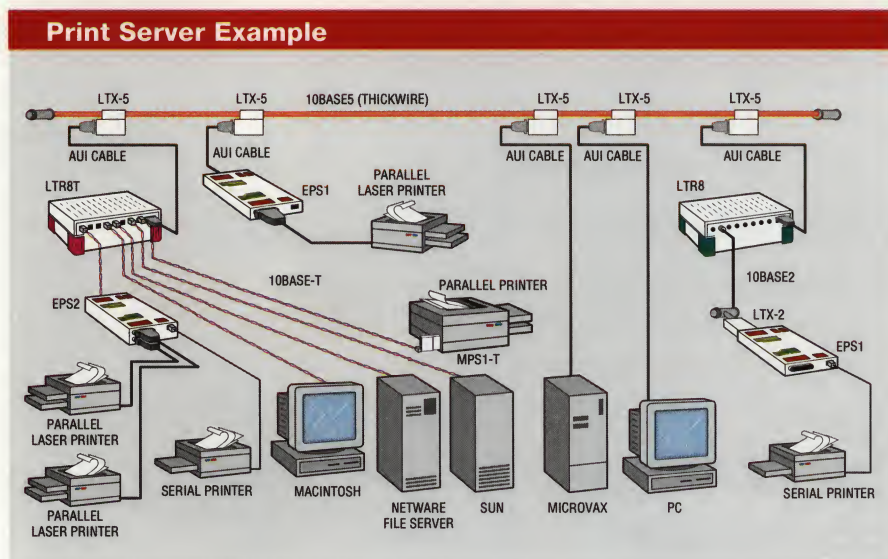
For example, a laser printer can print a postscript job from a Macintosh one minute and then next minute can print a text job from a Novell file server. Lantronix's family of print servers provide solutions to meet almost any network printing need. The MPS1 Micro Print Server and the EPS2/EPS1 print servers can be

thought of as "universal" in their ability to provide printing services on most any network.

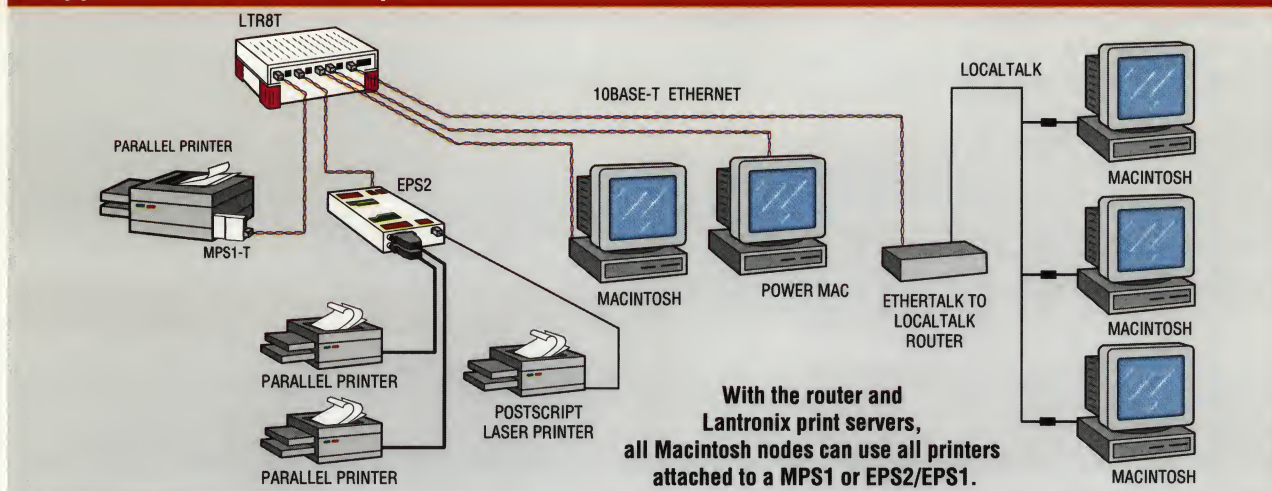
Protocols

One of the greatest advantages of network printing is the ability of users running different protocols to access the same printer. A protocol is a set of rules for communication over a network between two nodes; protocol compatibility means that two nodes are able to maintain a logical connection and exchange data. IPX, TCP/IP, AppleTalk/EtherTalk, NetBIOS/NetBEUI and LAT (DEC) are the protocols that dominate most Ethernet networks today. The MPS1 and EPS2/EPS1 print servers are able to service printing requests from hosts running these protocols through means of a server queue. As print requests arrive at the server, they enter the queue; as printer resources become available, each print job is handled in turn. Queued entries are handled on a "first-in, first-out" basis, regardless of protocol. The MPS1 and EPS2/EPS1 servers can print from any host running any of the supported protocols. In addition, the EPS2 and EPS1 servers can print on all ports simultaneously.

There is usually more than one way to issue print jobs from a host; the MPS1 and EPS2/EPS1 are capable of supporting most all of the current printing options from most operating systems supporting the Ethernet 802.3 standard. In Novell NetWare networks, Lantronix's print servers support both NetWare Print Server and NetWare RPrinter applications. For



AppleTalk Network Example



Novell 4.x networks, the EPS/MPS product families support Novell's NetWare Directory Services (NDS). Both remote service and remote port connections are supported for DEC's LAT; and for UNIX hosts, support is available for Berkeley Remote printing (lpd), telnet and rlogin sessions, raw telnet connections and Lantronix's own RTEL software. Lantronix's RTEL software is supported on the following platforms; HP/UX, SGI, AIX, Ultrix, SCO, Sun/OS and Solaris. NetBIOS printing using Windows NT and OS/2 hosts is supported under LAN Manager, with DLC also available from Windows NT; AppleTalk printing is supported for local zones (default) or for network-wide applications.

Interfaces

Supporting a variety of protocols dictates that a print server should provide a variety of interfaces for network printing. With Lantronix's print server family, users are provided with a comprehensive selection of interfaces for both printers and networks. On the printer side, the compact MPS1 Micro Print Server provides a single male Centronics parallel connector that attaches directly to the printer without the need for additional cables. The EPS2 and EPS1 print servers support both serial and parallel interface ports. Both EPS units support a single serial interface. Where the EPS1 supports one parallel interface, the EPS2 supports two; one parallel port on each unit can be configured as either a Dataproducts or Centronics interface (the extra one on the EPS2 is Centronics only). One Centronics cable and one serial cable are provided with each EPS2 and EPS1 print server. As well as connecting printers, the serial interface can also be used for dial-out modems or process control devices. The parallel interface ports on the MPS1 and EPS2/EPS1 servers support the HP Bitronics interface standard for bidirectional parallel communications. This feature is particularly useful when using printers with Macintosh hosts as the Macintosh often requires bidirectional

communication with the printer to receive font information.

On the network side, the MPS1 servers are equipped with either an RJ45 connector for use with 10BASE-T (twisted pair) Ethernet or a BNC connector for use with 10BASE2 (thin coax) Ethernet. The EPS2 and EPS1 are both equipped with an AUI port for connection to standard transceivers that can support virtually any Ethernet media type and an RJ45 connector for 10BASE-T.

Management

Management of the various printing resources offered by Lantronix's Universal Print Servers is provided for by EZCon, Lantronix's new graphical management software package. EZCon allows the user to select menu options from a GUI-based window on PCs running Windows over NetWare or WinSock, Unix and Macintosh platforms. EZCon automatically locates all Lantronix products on the network and allows the user to perform installation and management functions by simply clicking on the correct icons and making the necessary choices.

In addition to EZCon, Lantronix's EPS2, EPS1 and MPS1 print servers also support Telnet and DECnet logins which enable easy access to Lantronix's print servers from any host supporting Telnet or DEC hosts. The EPS2 and EPS1 servers allow logins from the serial port for diagnostic and configuration purposes. The serial cable included for printing may be used to connect a terminal for this function. Last but not least, SNMP management support is available, with RFCs for 1066 (MIB I), 1213 (MIB II), 1316, 1317 and 1318.

MPS1 Features

- ▼ IPX (Novell NetWare), TCP/IP (Unix), AppleTalk (Macintosh/ EtherTalk), NetBIOS/NetBEUI (LAN Manager/Windows NT) and LAT (DEC) protocols supported.

- ▼ Compact size: Connects directly to the printer's Centronics parallel port.
- ▼ EZCon GUI (Graphical User Interface) configuration program included.
- ▼ Parallel port burst rates up to 150 Kbps.
- ▼ MPS1-T: 10BASE-T interface connector.
- ▼ MPS1-2: 10BASE2 interface connector.
- ▼ Direct attachment: printer cables not required.

EPS2/EPS1 Features

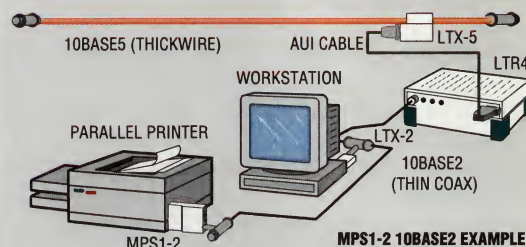
- ▼ IPX (Novell NetWare), TCP/IP (Unix), AppleTalk (Macintosh/ EtherTalk) and NetBIOS/NetBEUI (LAN Manager/Windows NT) protocols supported standard. LAT (DEC) requires license.
- ▼ 1 Serial Line, Speeds of 300 bps to 115 Kbps.
- ▼ EPS2: 2 Parallel Ports (1 Centronics and Dataproducts compatible; 1 Centronics compatible only; burst rates up to 150 Kbps).
- ▼ EPS1: 1 Parallel Port (Centronics and Dataproducts compatible).
- ▼ EZCon GUI (Graphical User Interface) configuration program included.
- ▼ AUI and 10BASE-T Ethernet interface connectors.
- ▼ Parallel and serial cables available.

Additional Features

The MPS1 and EPS2/EPS1 print servers also contain a number of features that have come to be identified with Lantronix products:

- ▼ Flash ROMs: they load the server's operation program when it powers on. They also have the ability to upgrade via a network download.
- ▼ Free software updates: available by ftp over the Internet or via BBS modem connection.
- ▼ 5-year limited warranty.

MPS1 Print Server Example



Print Servers

PART NO.	DESCRIPTION
MPS1-T-01	Micro Print Server, Flash ROM, plugs directly into parallel printer port, (Centronics/Bitronics compatible), 10BASE-T network interface, diagnostic LEDs, manual, test/reset switch, EZCon (GUI configuration program for Novell, Unix and Macintosh platforms), 120 VAC external power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk, NetBIOS/NetBEUI and LAT (DEC) support .
MPS1-T-02	Same as above with 220 VAC external power supply.
MPS1-2-01	Micro Print Server, Flash ROM, plugs directly into parallel printer port, (Centronics/Bitronics compatible), 10BASE2 network interface, diagnostic LEDs, manual, test/reset switch, EZCon (GUI configuration program for Novell, Unix and Macintosh platforms), 120 VAC external power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk, NetBIOS/NetBEUI and LAT (DEC) support .
MPS1-2-02	Same as above with 220 VAC external power supply.
EPS1-01	Universal Print Server, Flash ROM, 1 serial and 1 parallel printer port (Centronics/Bitronics compatible), 10BASE-T and AUI network interfaces, diagnostic LEDs, manual, 6 ft. Centronics printer cable, 1 ft. serial cable with configurable DB25 connectors, EZCon (GUI configuration program for Novell, Unix and Macintosh platforms), 120 VAC external power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk and NetBIOS/NetBEUI support (LAT support optional).
EPS1-02	Same as above with 220 VAC external power supply.
EPS2-01	Universal Print Server, Flash ROM, 1 serial and 2 parallel printer ports (Centronics/Bitronics compatible), 10BASE-T and AUI network interfaces, diagnostic LEDs, manual, 6 ft. Centronics printer cable, 1 ft. serial cable with configurable DB25 connectors, EZCon (GUI configuration program for Novell, Unix and Macintosh platforms), 120 VAC external power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk and NetBIOS/NetBEUI support (LAT support optional)..
EPS2-02	Same as above with 220 VAC external power supply.
OPT-PAK	RTEL software for UNIX for use in non-lpd supported systems, 3.5" floppy, documentation included.
LAT-EPS1	LAT license for EPS1, required on a per unit basis.
LAT-EPS2	LAT license for EPS2, required on a per unit basis.
500-008	Serial cable, RJ45 to female DB25 with male DB25, 6ft.
500-011	Parallel cable, male DB25 to male Centronics, 6ft.

RMON Probes



Managing networks today is becoming increasingly difficult with recent trends to decrease network management staffing and the increasing complexity of networks. But a new class of network management tools based on Remote Monitoring (RMON), an adjunct to the Simple Network Management Protocol (SNMP) standard, is emerging to combat these new network management problems.

For many years, the SNMP management station has been a popular tool to listen for a properly functioning network. Primarily consisting of software running on a PC or workstation, the SNMP management station is able to communicate with the various devices on a network that contain an SNMP agent and detect possible problems that demand attention. If the network is functioning properly, it is the SNMP management station's primary task to display and log network statistics in easy-to-interpret information management displays.

While SNMP was designed to look at network devices, it was not designed to look at the network in a holistic fashion. In 1991 the RMON protocol was created by the IETF and defined in RFC number 1757. Just as SNMP operated with the use of intelligent agents to constantly collect and send information, RMON uses intelligent agents to provide filtered data and information only when it is required by the SNMP management station. RMON is the perfect complement to SNMP. It reduces the polling that had previously hampered the use of SNMP on larger networks and extends the range of information that can be sent back to the SNMP manager.

RMON uses "smart" agents that respond on an exceptions-only basis. This reduces the traffic associated with network management and enables the remote equipment to still alert the SNMP management station when problems occur. By allowing the network manager to set thresholds, RMON enables probes to measure network performance. When the threshold for

acceptable network behavior is exceeded, the RMON probe alerts the SNMP management station to problem. The RMON protocol reports statistics at OSI layer two (the data link layer) although some new extensions now allow the reporting of OSI layer three (the network layer) information. A new RMON standard labeled "RMON II" is currently being approved and will enable RMON probes to completely provide information at OSI layer three.

General RMON Capabilities

The RMON definition (RFC1271) lays out nine categories for the collection of network statistics. These groups are:

1. Statistics Group: Collects data on media-access specific statistics such as number of packets, broadcasts, bytes, errors and collisions. This group also includes helpful information on packet sizes and packet size errors such as under- or over-sized packets.
2. History Group: Captures the statistics for the historical recording of the data. The administrator can set the number of samples and the sample intervals of the information to be recorded.
3. Host Table Group: Examines node-specific traffic statistics such as packets received, broadcasts and error packets sent. Also collects information on new nodes added to the network.
4. HostTopN Group: Collects rate-based statistical data on a selected set of hosts for a particular statistic type. Up to 64,000 entries can be maintained for this RMON group.
5. Traffic Matrix Group: Maps the number of packets and errors sent between source and destination nodes.
6. Alarm Group: Allows for the configuration of thresholds based on sampling intervals to provide notification to SNMP management stations that a

potential problem exists on the network.

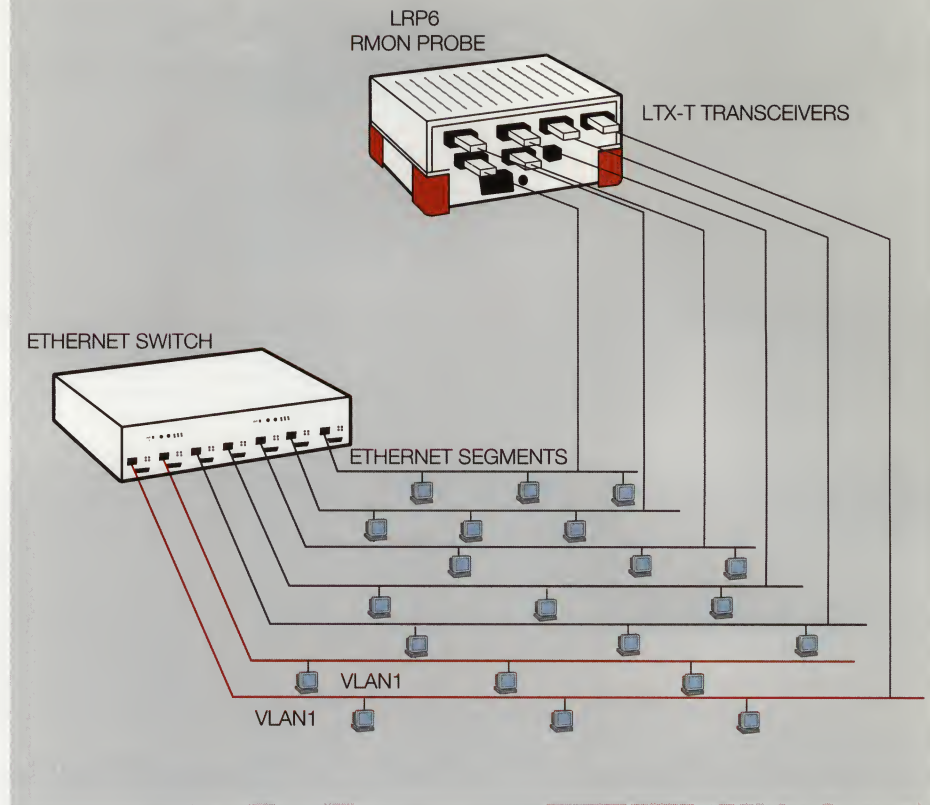
7. Filter Group: Allows the matching of packets with a filter that will then trigger a packet capture event. An example of this is a filter that isolates TCP packets between a particular source and destination that are greater than 1,000 bytes but less than 1,500 bytes. A filter like this could allow a network manager to isolate and measure the affect of a new service that was installed on a server, such as the downloading of video clips from a World Wide Web server.
8. Packet Capture Group: Provides a buffer to capture packets and a trigger mechanism to automatically activate trace collection.
9. Event Group: This category provides the integration of the SNMP trap mechanism into RMON. These are notifications that will be sent to the SNMP management station when a certain defined event occurs on the remote network.

Lantronix RMON Solutions

Lantronix has recently added to its network management portfolio of products two multiport RMON probes, the LRP6 and the LRP2. The LRP feature set includes:

- ▼ The LRP6 and LRP2 are multiport RMON probes with full SNMP and RMON support. Each probe can be configured to monitor up to nine RMON groups.
- ▼ The LRP6 and LRP2 have powerful analysis tools, including triggers for "Roving RMON" in-depth analysis.
- ▼ Both products include EZMon, a GUI-based snap-in application for HP OpenView for easy configuration, in-depth information management reporting and menu driven in-band and out-of-band management. Both LRP probes also work with all other SNMP management software that has support for RMON.

RMON Probe Example



- ▼ Lantronix's LRP RMON probe has a 5-year limited warranty and free software upgrades which includes planned support for the emerging RMON II standard.

Roving RMON

In the LRP family, Lantronix has included an implementation of Roving RMON. This capability allows the LRP to focus more detail on a problem LAN segment. For instance, the LRP in a standard operating mode monitors all connected LAN segments with four basic RMON groups:

- ▼ RMON Statistics Group
- ▼ RMON History Group
- ▼ RMON Event Group
- ▼ RMON Alarm Group

The administrator can use Roving RMON to provide additional information on a particular segment of interest. The additional information groups available with Roving RMON are:

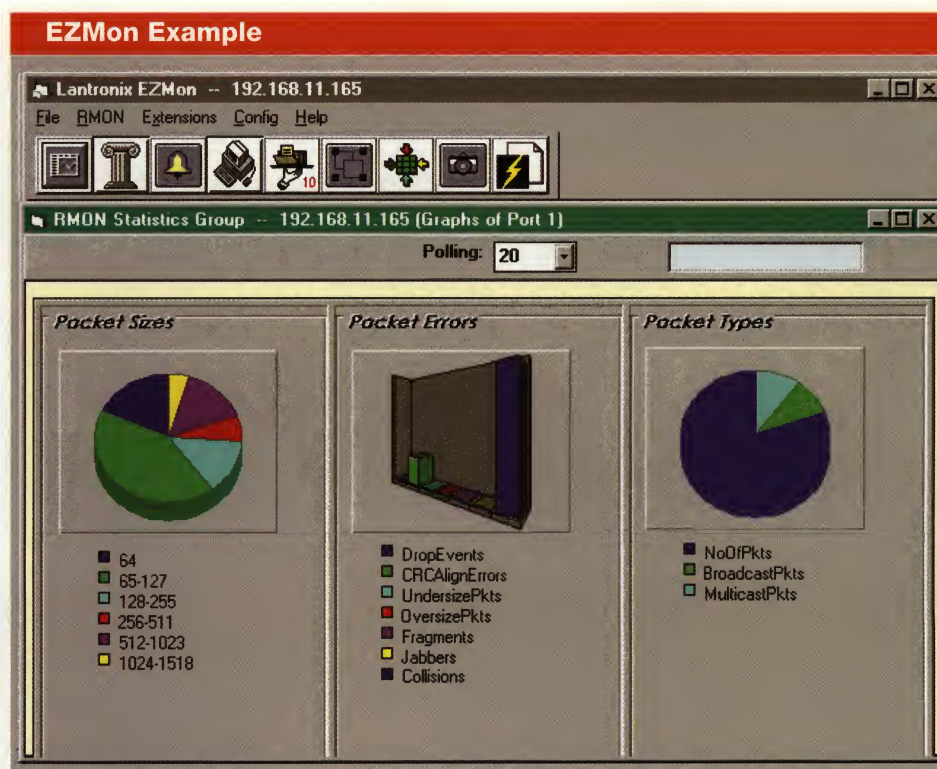
- ▼ SNMP MIB II Lantronix Extensions
- ▼ RMON Host Group
- ▼ RMON HostTopN Group
- ▼ RMON Matrix Group
- ▼ RMON Filter Group
- ▼ RMON Capture Group

If a threshold is exceeded on one of the ports, a trigger can cause Roving RMON to automatically focus attention on the problem port and signal the SNMP management station with a trap that the condition occurred. Triggers for Roving RMON can be set for packets per second, bytes per second, errors per second, and total errors. Threshold can also be set for information contained in the SNMP EtherStats group which include CRC alignment errors, undersized packet errors, oversized packet errors, jabber errors and collisions. The LRP RMON probe provides the network administrator six ports of simultaneous monitoring to provide a cost effective method of tracking the performance of remote LAN segments. With Roving RMON, the LRP can provide extensive information about problematic LAN segments. In addition to Roving RMON, each LRP port can be manually configured to support the various RMON groups.

EZMon

For customers who use HP OpenView for Windows SNMP manager, EZMon is a snap-in application that provides added capabilities for extracting information from the Lantronix LRP RMON probe. The additional screens provided in EZMon allow for the remote configuration of the LRP in an easy-to-use graphical interface. Additional information management capabilities are added and provide the network manager an extensive tool set for the tracking of network performance and failures. Some features that EZMon provides the network manager are:

- ▼ Seven layer protocol decode



- ▼ Conversation trace utility
- ▼ TopN station analysis
- ▼ Packet filter and capture utilities

Lantronix Solutions For Switched Networks

Lantronix continues to provide switched Ethernet solutions by providing not only Ethernet switches, but also multiport protocol analyzers and multiport RMON probes for managing switched networks. Lantronix LRP RMON probes complement the Lantronix LNA protocol analyzers for switched network management. The SNMP extension of RMON allows for the listening and monitoring of remote networks. When problems are detected by the LRP, the LNA protocol analyzer can be used to isolate the problem at a very high level of data analysis. This commitment to the switched network market not only provides the network manager with the bandwidth to meet today's demanding users, but also the network tools to ensure adequate performance and a trouble-free network.

RMON Probes

PART NO.	DESCRIPTION
LRP6	RMON Probe, 6 AUI ports, 1 RJ45 serial port, EZMon HP Openview management applet, installation guide, CD-ROM includes all software and reference manual, internal auto-switching power supply.
LRP2	RMON Probe, 2 AUI ports, 1 RJ45 serial port, EZMon HP OpenView management applet, installation guide, CD-ROM includes all software and reference manual, internal auto-switching power supply.



Network Analyzers



Switched Ethernets increase network throughput and performance via the splitting of a single network into smaller high-performance segments. With this segmentation, however, the network manager introduces a challenging management problem - how to manage, control and troubleshoot those various segments. Where once the network manager was able to use an Ethernet protocol analyzer on a single segment network and see all traffic, on the switched network they must find ways to observe and troubleshoot problems on multiple segments.

Current protocol analyzer products fall into two separate categories: (1) inexpensive software solutions that demand dedicated PC platforms for each segment and provide small feature sets, or; (2) enterprise-wide analyzers requiring expensive central site management software and remote probes for network segments.

LNA Network Analyzers - A Multiport Solution for Switched Networks

Lantronix has developed the LNA6 and LNA2 network analyzers with the switched network environment in mind. Each LNA supports multiple Ethernet segments from a single unit. Each LNA offers the network manager several pathways to obtaining information about those segments: (1) GUI-based management software running on a PC; (2) telnet login from any network IP host; (3) connection to the serial port on the LNA via a terminal or modem. Each LNA contains sophisticated management features to identify key elements in network performance. Network managers can also use the LNA to set triggers and alarms that can send a variety of alerts automatically. Each LNA can capture Ethernet packet data either on demand or via a trigger condition. The LNAs can also analyze and decode network packet traces up to seven layers deep in the OSI model. With an emphasis on proactive network monitoring features, the LNA

analyzers help the busy network manager to quickly spot potential problems before they develop into catastrophes.

Network Monitoring

Traditional network analyzers provide only a minimum of network monitoring capability due to the fact that they are designed as portable troubleshooting devices - find a problem segment and then move the analyzer to that segment for investigation. Because the LNAs are multiport analyzers and can therefore remain attached to key segments, Lantronix has designed them to be portals through which the network manager can monitor those segments. The basic areas of segment monitoring supported on the LNAs are: packet errors, frame sizes, top traffic-generating Ethernet nodes (listed by address) and most active protocols. This monitoring is available on all LNA ports anytime and from any of the interfaces for the device.

In addition to the basic monitoring function, however, the LNA's ability to log alarm conditions and respond to those alarms in a number of ways provides even greater utility for the network manager. One set of alarm features are designed to catch network errors. To set these alarms, the network manager can specify particular threshold values for network loading, error counts or packet rates. Another set of alarms help network managers catch malfunctioning network equipment before it causes a problem. The LNAs support a listing of IP host addresses that can be pinged at regular intervals to verify their operation.

When these thresholds are reached, or a ping to a host goes unanswered, an alarm condition is recorded and the LNA will respond. Alarm responses include sending a command to the serial port to a modem and/or a pager, "freezing" the monitoring activities to capture the state of the network when the error occurred or initiating a capture of network traffic in a

buffer. These features allow the LNAs to provide 24-hour coverage of the segments to which the LNAs are attached.

Capturing Network Traffic

The ability to capture Ethernet packet traffic is key to troubleshooting network problems. The LNA provides the network manager with a number of tools for ensuring that the correct information is located. As mentioned previously, a capture can be initiated by any one of a number of alarm conditions. The data that is being captured can be filtered at several levels as determined by the network manager, including Ethernet address, protocol or by frame offsets within the packets. Buffers for each port allow for either free-running captures or for filtered ones.

Decoding Network Traffic

Once a buffer of packet data is captured, LNA network analyzers provide decoding capability for TCP/IP, IPX (Novell), AppleTalk, DECnet, Banyan VINES and XNS protocols.

Filtering Network Traffic

The LNA protocol analyzers provides extensive filtering capabilities to isolate and observe network traffic. Pre-set "canned" filters are available to quickly observe well-known traffic type like WWW, Lotus Notes, NetWare and many others.

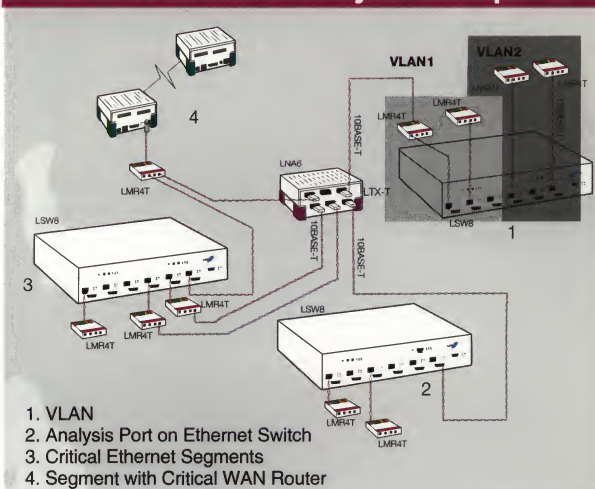
Serving the Switching Environment

The Lantronix LNA network analyzers can be deployed in a number of different ways to assist the network manager depending on the switching environment - here are a few such applications:

1. Attachment to a dedicated analysis port. Many switches offer the capability to "mirror" or forward all traffic from a single or selected segments to one port on the switch. With an LNA attached to that port, all of the traffic on the switch can be monitored. An LNA6 connected in this manner could monitor six switches - if 24 ports each, 144 segments could be monitored. This is recommended for switches that are supporting a single, or small number of users per port.

2. Attachment to segments on a cut-through switch: Because cut-through switches examine only a portion of the Ethernet packet, they sometimes may

Switched Network Analyzer Example



forward error packets and create network problems. When attached to network segments on cut-through switches, the LNA can provide an extra measure of monitoring on those segments and ensure that problems caused by bad packets are avoided.

3. Attachment to VLANs: As Virtual LANs become more popular, the LNA can be a useful device in monitoring the health of an entire VLAN. By connecting an LNA port to any segment in a VLAN broadcast domain, the LNA will be able to examine all traffic between VLAN members. In an environment where several VLANs have been created on a switch, a multiport LNA can monitor each VLAN and ensure integrity of that collision domain.

In addition to the ability to trace and analyze network packet traffic, the Lantronix LNAs have the ability to generate network packet traffic for both device and network topology testing. The network manager can choose, on a per port basis, the network loading level, the number of error frames to be included and the protocol type to be generated.

All Lantronix products come equipped with this memory and allows each unit to load its operating system internally on power up and to also download software from a network host if software upgrades are desired. Software updates are free over the Internet or via BBS. The LNA6 and LNA2 are also covered by Lantronix's five-year limited warranty.

Network Analyzers

PART NO.	DESCRIPTION
LNA6	6-port Ethernet Analyzer, Flash ROM, 6 AUI ports for connection to Ethernet network, 1 RJ45 serial port for modems/configuration, EZMan GUI management software included, Installation guide, CD-ROM with software and reference manual, Monitors, captures and decodes Ethernet traffic on each port simultaneously, Multiport wire speed traffic generation capability.
LNA2	2-port Ethernet Analyzer, Flash ROM, 2 AUI ports for connection to Ethernet network, 1 RJ45 serial port for modems/configuration, EZMan GUI management software included, Installation guide, CD-ROM with software and reference manual, Monitors, captures and decodes Ethernet traffic on each port simultaneously, Multiport wire speed traffic generation capability.

Terminal/Printer Servers



Terminal/printer servers offer a reasonably priced, flexible way of connecting users and peripherals to one or more host computers on an Ethernet network. Terminals attached to a server can connect to any host on the network that is running a supported protocol. Additionally, a terminal server can support multiple connections allowing a user to "timeshare" between several different hosts even if they each run a different protocol. In some cases, servers can support terminals that can display two sessions on the same terminal screen.

Printer servers allow printers to be shared by different computers, including Apple Macintoshes, Windows PCs and UNIX (DEC, Sun, IBM and HP), each running a different networking protocol. Printer servers can also provide protocol translation, allowing printers previously available only to certain computers to become available to all computers using protocols supported by that server.

Lantronix offers a full line of terminal and printer server products. The ETS16 and ETS8 are terminal servers with 16 and eight serial ports respectively with terminal connection and serial printing capability on each port; the EPS4 four-port printer server offers similar serial port features with an additional fifth parallel printer port. Lantronix also offers several related products: the EPS2, EPS1 and MPS1 print servers (see page 6), the LRS16 and LRS2 remote access servers (see page 3) and the MSS1 micro serial server (see page 17).

Terminal Service

Each Lantronix terminal/printer server can support TCP/IP and DEC LAT terminal service. TCP/IP, which evolved from the UNIX community, is a flexible, routable and almost universally accepted protocol. TCP/IP uses unique network addresses and complex routing services to allow users to connect to systems on both local and wide area networks. LAT

was developed by Digital Equipment Corp. as a local area networking protocol primarily for DEC systems. LAT utilizes multicasts to make local resources known to network users; it is timing dependent and utilizes common names for the identification of network nodes.

Each Lantronix terminal/printer server can support up to eight terminal sessions on an individual port. Each session may be connected to a different network device; user "multi-tasking" on those sessions is accomplished by switching between them with a user-specified hot key.

In addition to the physical ports available on its servers, Lantronix also offers a number of "virtual" ports - ports that are available by making either a LAT connection to the server's name or by making a telnet connection to the server's IP address. Virtual ports on the Lantronix servers function exactly the same as regular ports, supporting multiple sessions and offering connectivity to users running protocols supported by the server.

Printer Service

All of the Lantronix ETS/EPS products can support network printing via IPX, TCP/IP, AppleTalk/EtherTalk, NetBIOS/NetBEUI and LAT protocols. In the TCP/IP environment, the Lantronix servers support Berkeley remote printing (lpd) which is standard on most UNIX hosts. Lantronix also offers its own RTEL software for situations where the host does not support lpd or where additional functionality is required. For Novell IPX users, print server emulation is provided to allow transparent network printing from IPX-based file servers or PCs. AppleTalk printing support also is provided for Macintosh computers running EtherTalk on Ethernet. For PCs running Microsoft LAN Manager, Microsoft Windows NT or IBM OS/2, the ETS/EPS units support NetBIOS printing (using NetBEUI). Under Windows NT, DLC printing also is

supported. The servers allow each protocol to be enabled or disabled and feature configuration options for AppleTalk zoning and Novell network partitioning.

Modem Service

Each serial port on a Lantronix ETS/EPS unit can be configured to be used with modems with support for DTR and DSR (or DCD) signals. For dial-in applications, a "dial back" option is available that requires verification of incoming users against a predefined list of approved users. If the incoming user name is not present, then that port is logged out immediately. Dial-out service is available for LAT and TCP/IP protocols. The ETS/EPS products also support SLIP (serial line internet protocol) for TCP/IP communication over a serial line between two nodes.

Protocol Conversion

A valuable feature of the Lantronix ETS/EPS server family is protocol conversion which allows computers running different protocols to be connected. A simple example of protocol conversion is a user at a Sun workstation running TCP/IP who wants to log into a VAX system running LAT. By making a telnet connection to a Lantronix server, the user now is on a virtual port that provides access to all LAT and TCP/IP nodes available on the network. The protocol conversion capability also allows a LAT user to use the routable TCP/IP protocol across the wide area network to reach a remote LAT host. In this

situation, the LAT user connects into a Lantronix server that allows him to connect through a TCP/IP gateway to another network. On the remote network, the user logs into another Lantronix server, allowing him to connect to a VAX node on that network.

Server Management

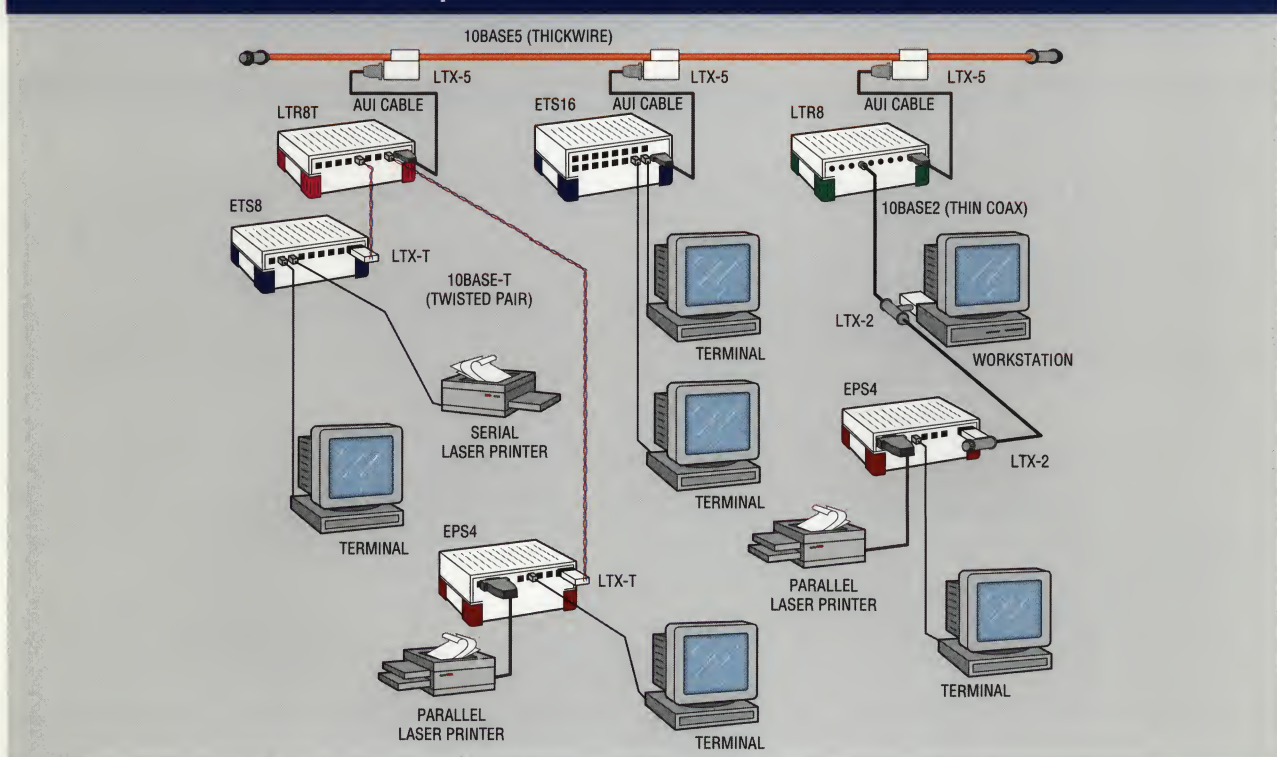
Lantronix servers can be managed both locally and remotely from other locations on the network. Remote logins to the servers are supported using TCP/IP, DEC's TSM and DECnet protocols. For the ETS/EPS products, Lantronix's MACCON and EPSCON software utilities allow direct login to the servers from remote Apple and Novell hosts respectively. SNMP support is offered for the following RFCs: MIB I (RFC 1066), MIB II (RFC 1213), Parallel Printer MIB (RFC 1316), RS-232 MIB (RFC 1317), Character MIB (RFC 1318). SNMP support allows the server to be managed by third-party network management software packages.

Hardware Features

Lantronix server products have the following hardware features that are designed to increase ease of use:

- ▼ Flash ROM: Flash ROM is standard on all Lantronix servers. This ROM allows the server to boot its operating program without the need for a network load host. In addition, this ROM can be updated remotely with new software.

Terminal/Printer Server Example



- ▼ **Serial Connectors:** The ETS/EPS units have universal connectors that are capable of supporting both RJ12 and MMJ-type (DEC) serial adapters.
- ▼ **Network Ports:** All Lantronix server products offer the convenience of AUI ports for network connections. This enables them to be used with any 802.3 Ethernet media.

Software Upgrades

Lantronix's free software upgrade policy helps you keep all of your Lantronix server products up to date as changes are made in computer operating systems. These upgrades can be achieved in one of several ways: ftp download via the Internet from the Lantronix ftp server; file transfer from the Lantronix bulletin board service; hard copy media in eight different formats (small charge applies for media).

Terminal/Printer Servers

PART NO.	DESCRIPTION
ETS16UF	16-Line Terminal/Printer Server, Flash ROM, 16 RS423 interface connectors (RS232 compatible), with universal serial connectors that accept RJ12 or MMJ-style plugs. AUI network interface connector, manual. Current software installed, includes media kit with RTEL source and binaries on diskette. Internal auto-switching power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk and NetBIOS/NetBEUI support (LAT support optional).
ETS8UF	8-Line Terminal/Printer Server, Flash ROM, 8 RS423 interface connectors (RS232 compatible) with universal serial connectors that accept RJ12 or MMJ-style plugs. AUI network interface connector, manual. Current software installed, includes media kit with RTEL source and binaries on diskette. Internal auto-switching power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk and NetBIOS/NetBEUI support (LAT support optional).

Printer/Terminal Servers

PART NO.	DESCRIPTION
EPS4UF	5 Line Printer/Terminal Server, Flash ROM, 4 RS423 interfaces (RS232 compatible), with universal serial connectors that accept RJ12 or MMJ-style plugs, 1 parallel printer port, DB25 with Centronics and Dataproducts support. AUI network interface connector, manual and 6 ft. Centronics cable included. Current software installed includes media kit with RTEL source and binaries on diskette. Internal auto-switching power supply, concurrent IPX, TCP/IP, AppleTalk/EtherTalk and NetBIOS/NetBEUI support (LAT support optional).

Accessories

PART NO.	DESCRIPTION
<i>Cabling kits for ETS16, ETS8 and EPS4 serial lines, available in package of four, including DB25 connectors (user-configurable pinouts), 1 ft. cabling.</i>	
CK-FR	4 x DB25 female adapters, RS232 compatible, 4 x 1 ft. cables with RJ12 adapters. For ETS16, ETS8 and EPS4 only.
CK-MR	4 x DB25 male adapters, RS232 compatible, 4 x 1 ft. cables with RJ12 adapters. For ETS16, ETS8 and EPS4 only.
500-004	Dataproducts printer cable for EPS Printer/Terminal Server, 6 ft.
500-011	Parallel cable, male DB25 to male Centronics, 6 ft.
LAT licenses for ETS16, ETS8, EPS12 and EPS4.	
LAT-ETS16	LAT license for ETS16, required on a per unit basis.
LAT-ETS8	LAT license for ETS8, required on a per unit basis.
LAT-EPS4	LAT license for EPS4, required on a per unit basis.

Micro Serial Servers

Traditional terminal servers support terminals and other serial devices on networks. A new breed of terminal servers, known as a single port serial server, is now entering this market providing the benefits of serial-to-Ethernet conversion with the cost effectiveness of a single-port device. Single port servers enable a serial device to be connected to any networked host running a supported protocol.

The Lantronix MSS1 is the first single port, multiprotocol serial server to be introduced into this market. In addition to providing traditional terminal server use, the MSS1 connects almost any device with a serial port, such as a UPS, bar code scanner or climate control device, directly to an Ethernet network.

Serial Connection Service

TCP/IP, IPX, and LAT are the LAN/WAN protocols used most often by most terminal servers. Lantronix's MSS1 supports these protocols, allowing the necessary data conversion between any host on the network and the device on the server. The MSS1 also gives the serial device the ability to handle the bi-directional data flow associated with network communications.

The MSS1 supports serial performance up to 115.2 Kbps, and includes autobaud capability to adapt automatically to the serial device's data rate. The MSS1 automatically opens connections when it powers up, eliminating the need for a manual request. Modem controls (DSR/DTR) and functions such as DSRlogout, DTRwait, and SignalCheck are also supported for dial-out modem applications.

In addition, the MSS1 can specify preferred and dedicated target hosts. This enables the network environment to be customized and maximizes the use of valuable computing resources.

Server Management

The MSS1 can be managed directly by the server's physical port as well as remotely from other network locations. Remote logins are supported using TCP/IP (telnet), DEC's TSM and DECnet protocols.

The MSS1 comes with EZCon software for



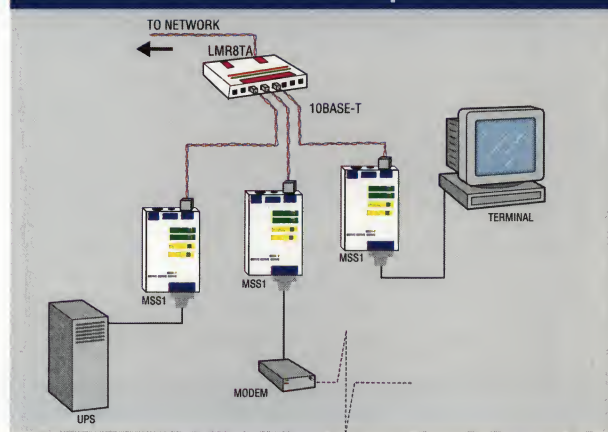
graphical installation and configuration from Novell and Unix systems. The MSS1 also supports the Simple Network Management Protocol (SNMP) for management by a wide range of SNMP-based systems.

Hardware Features

The Ethernet interface that comes standard on the MSS1 is a 10BASE-T, RJ45 connector. The MSS1 has a DB25-style serial connector for connecting to the serial device. Flash ROM allows the operating program to boot without a network loadhost. In addition, is ROM that can be downloaded with new software for easy upgrades.

The MSS1 comes with a 5-year limited warranty.

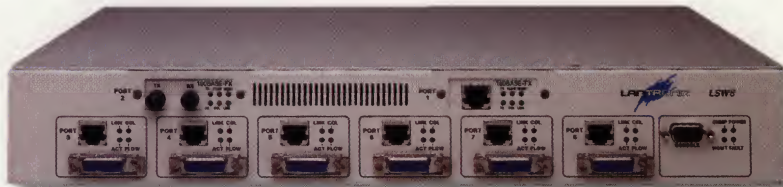
Micro Serial Server Example



Micro Serial Servers

PART NO.	DESCRIPTION
MSS1-T-01	Micro Serial Server, Flash ROM, 1 DB25 serial port, RJ45 Ethernet connection, concurrent IPX, TCP/IP and LAT support. CD-ROM containing EZCon GUI software, reference manual and installation guide. Diagnostic LEDs and external 120VAC power supply.
MSS1-T-02	Same as above with 220VAC power supply.
500-016	Null-modem cable, female DB25 to female DB25, 10 ft.
500-017	Null-modem cable, female DB25 to male DB25, 6 ft.
500-018	Modem cable, female DB25 to female DB25, 6 ft.
500-019	Modem cable, female DB25 to male DB25, 6 ft.

Ethernet Switch With Fast Uplink Ports



Lantronix's LSW8 is an Ethernet store-and-forward switch capable of supporting six Ethernet segments using either AUI or 10BASE-T (RJ45) interfaces. As a segment switch, the LSW8 can support a complete Ethernet on each port and a total of up to 2,048 Ethernet addresses over the switch. Additionally, the LSW8 boasts two 100 Mbps uplink ports capable of supporting optional modules for 100BASE-TX or 100BASE-FX Fast Ethernet. Full and half duplex operation is selectable on all of the switch ports, allowing the LSW8 to be used with other devices supporting the full duplex mode.

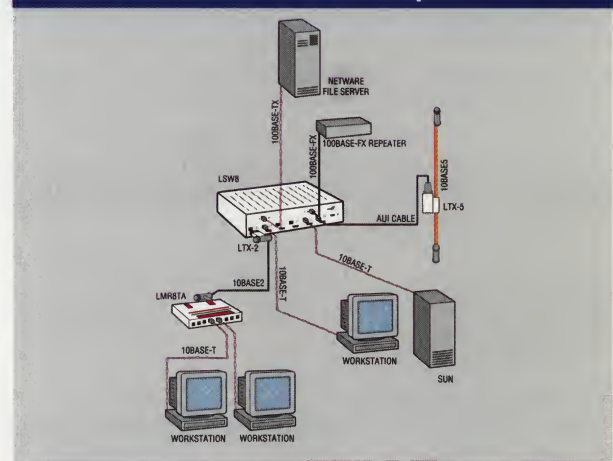
Filtering and forwarding in the LSW8 takes place at wire speed, ensuring maximum throughput to the attached Ethernet segments. The LSW8 also features back-pressure flow control to maximize network performance during peak usage periods and eliminate dropped packets. The LSW8 supports the creation of virtual LANs - these LANs are groupings of individual network nodes that can span several different network segments.

To manage both the switch and the attached segments, network managers can use an SNMP management station or simply telnet into the LSW8 from any IP host. The LSW8 ships with ONMP, a

software module for HP OpenView for Windows. The LSW8 also contains Flash ROM, which can be upgraded in the field with software downloaded from the Lantronix BBS or Internet ftp site.

The LSW8 is covered by a one-year limited warranty, with extra coverage available for up to five-years inclusive.

Fast Ethernet Switch Example



Ethernet Switches

PART NO.	DESCRIPTION
LSW8	Six-port Ethernet switch (AUI or 10BASE-T selectable). 2 optional 100Mbps uplink ports capable of supporting 100BASE-TX or 100BASE-FX modules from Lantronix (LSW-TX, LSW-FM, LSW-FS). Half or full duplex Ethernet selectable each port. Rackmount hardware, Users guide, SNMP and ONMP software included.
LSW-TX	100BASE-TX fast uplink module for use in LSW8.
LSW-FM	100BASE-FX (multimode) fast uplink module for use in LSW8.

Fast Ethernet Repeaters/Hubs



The demand for higher transmission speeds for near-term network growth has been realized by the new Fast Ethernet specification (IEEE 802.3u) known as 100BASE-T. This new LAN standard has raised the Ethernet speed limit from 10 Megabits per second to 100 Megabits per second while only requiring minimal changes to the existing cable structure. Within the three types of Fast Ethernet standards (100BASE-TX, 100BASE-FX, and 100BASE-T4), 100BASE-TX has grown to be the most popular form of this network medium due to its close compatibility with the 10BASE-T Ethernet standard.

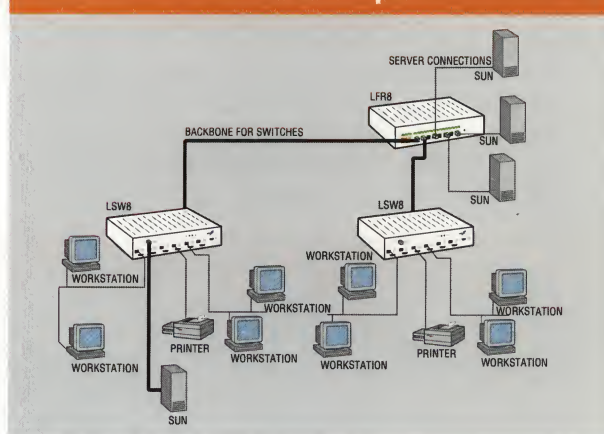
The building blocks of today's networks are a mixture of legacy 10BASE-T Ethernet networks and Fast Ethernet. Typically 10 Mbps networks utilize Ethernet switches (like the Lantronix LSW8) to improve the overall efficiency of the Ethernet network. Between Ethernet switches, Fast Ethernet repeaters (like the Lantronix LFR8) are used to connect a group of switches together at a higher 100 Mbps rate. Many client/server networks suffer from too many clients accessing the same server at the same time which creates a bottleneck where the server attaches to the LAN. Fast Ethernet, in combination with switched Ethernet, creates the perfect cost-effective solution for avoiding slow networks.

Most network managers will migrate from 10BASE-T or other Ethernet 10 Mbps variations to higher bandwidth networks. Typically, this starts at the workgroup with the replacement of hubs with Ethernet switches. These switches still operate at 10 Mbps speeds but help isolate and reduce traffic by localizing within segments. Eventually, Fast Ethernet ports on these switches will be used to provide even greater

bandwidth between the workgroups at 100 Mbps speeds. Equipment like the LFR8 Fast Ethernet Repeater will be used in common areas to group Ethernet switches together with server farms into 100 Megabit pipes. This is the cost effective method of growing most networks within the average enterprise. Both the LSW8 10/100 Ethernet Switch and the LFR8 Fast Ethernet Repeater (in addition to all of Lantronix Ethernet hubs and switches) are the perfect complement to a LAN growth strategy.

The Lantronix's LFR8 Fast Ethernet repeater is an eight port, Class II, Fast Ethernet repeater, the LFR8 includes one uplink port for connecting two repeater together. The LFR8 conforms to the 100BASE-TX standard and operates over Category 5 twisted-pair copper cable. The LFR8 comes standard with a 5-year limited warranty.

Fast Ethernet Hub Example



Fast Ethernet Hubs

PART NO.	DESCRIPTION
LFR8	Fast Ethernet repeater, 8 RJ45 ports, user guide.

Ethernet Switches and Bridges



When the number of users on an Ethernet network grows too large, the increased data traffic begins to slow that network's throughput. One easy way to improve performance is to segment these networks using a bridge or a switch. Bridges and switches are internetworking devices like repeaters. But where a repeater is used to link two networks together, bridges and switches are used to segment networks, creating multiple sub-networks that communicate with each other only when necessary.

The key differentiation between a bridge and a switch is the number of ports: a bridge has two, and a switch typically has more than four. Switches also can be built using "cut-through" technology, which provides a throughput boost by allowing the switch to read only the address of data packets. The competing "store-and-forward" technology of bridges and some switches, examines the entire data packet looking at the address and the other parts of the packet for errors.

LSB4 Ethernet Switch

The LSB4 is a four-port Ethernet switch. The LSB4 is self-learning and upon power up, it begins generating a map of network addresses. Once this map is built, the LSB4 automatically filters packets by the source and destination addresses. The LSB4

features full 10 Mbps wire rate filtering for each port to allow for high throughput through the device. The LSB4 also is capable of forwarding packets at the wire speed rate of 14,880 packets per second.

The Lantronix LSB4 offers filtering on protocols, addresses and user-defined patterns, which helps customize the throughput and security offered to each network segment.

LB2 Ethernet Bridge

The Lantronix LB2 Ethernet Bridge has a store-and-forward architecture that filters bad packets. The bridge offers a large number of packet filters that can be used to customize the unit for most network configurations and it supports the 802.1D Spanning Tree Algorithm for avoiding network loop conditions in bridged networks. Like the LSB4, the LB2 has a node table capable of holding 4096 nodes. Both devices also come complete with a serial port for out-of-band management.

The LSB4 and the LB2 may be remotely managed using SNMP (Simple Network Management Protocol) or by direct connection over the network via DECnet, TCP/IP, NetWare and AppleTalk.

The LSB4 and LB2 both come with a 5-year limited warranty.

Bridges/Switches

PART NO.	DESCRIPTION
LSB4	Ethernet Switch, self-learning with filtering and forwarding at full wire rate, 4096 node address table, SNMP management, Flash ROM, 4 AUI network interface ports, 1 RJ45 serial interface connector, 6 ft. serial cable with prewired DB25 connector, installation guide and reference manual, BRCON and MACCON software utilities on floppy diskette.
LB2	Ethernet Bridge, self-learning with filtering and forwarding at full wire rate, 4096 node address table, SNMP management, Flash ROM, 2 AUI network interface ports, 1 RJ45 serial interface connector, 6 ft. serial cable with prewired DB25 connector, installation guide and reference manual, BRCON and MACCON software utilities on floppy diskette.

Repeaters/Hubs - Twisted Pair



The LTRxT repeaters are engineered to provide up to 16 ports for twisted pair segments off of a single Ethernet connection. The LTRxT repeaters/hubs are designed to be "cascaded" with themselves and other hubs. In this form of operation, one of the 10BASE-T ports on the first repeater is configured as an interconnect between itself and a second repeater. The LTRxT units have a configurable MDI/MDI-X switch to allow inter-repeater wire segments to use conventional 10BASE-T wiring.

The LMRxTx mini repeater/hub products feature external power supplies, compact size and

multiple function LEDs. These devices can act as stand alone network hubs, or can attach to network backbones where extra 10BASE-T ports are needed. They can also be cascaded with other repeaters by providing an additional 10BASE-T cascade port as in the case of LMR8TA or when the proper cross-over cable is used.

All Lantronix repeater/hub products include:

- ▼ Link test function (switch-selectable in the LTRxT series).
- ▼ Automatic polarity reversal feature.
- ▼ 5-year limited warranty.

Twisted Pair Repeaters/Hubs

PART NO.	DESCRIPTION
INTERNAL POWER	
LTR16T	Unshielded Twisted Pair (UTP, 10BASE-T) Multiport Repeater, supports 16 UTP ports and 2 AUI ports, internal power supply, status and activity LEDs for each port.
LTR8T	Unshielded Twisted Pair (UTP, 10BASE-T) Multiport Repeater, supports 8 UTP ports and 1 AUI port, internal power supply, status and activity LEDs for each port.
EXTERNAL POWER	
LMR8TA-01	Unshielded Twisted Pair (UTP, 10BASE-T) Multiport Repeater, supports up to 8 UTP ports with 1 built in cascading UTP port, 1AUI/BNC port, 120 VAC external power supply, activity and link LEDs for each UTP port.
LMR8T-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 8 UTP ports and 1 AUI port, 120 VAC external power supply, status and activity LEDs for each port. (non-CE compliant*)
LMR4T-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 4 UTP ports, 1 AUI port, 120 VAC external power supply, status and activity LEDs for each port. (non-CE compliant*)
LMR8T-2-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 8 UTP ports and 1 BNC port, 120 VAC external power supply, status and activity LEDs for each port. (non-CE compliant*)
LMR4T-2-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 4 UTP ports and 1 BNC port, 120 VAC external power supply, status and activity LEDs for each port. (non-CE compliant*)
LMR9T-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 9 UTP ports, 120 VAC external power supply, status and activity LEDs for each port (non-CE compliant*)
LMR5T-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 5 UTP ports, 120 VAC external power supply, status and activity LEDs for each port. (non-CE compliant*)
LMR4TA-01	Unshielded Twisted Pair (UTP, 10BASE-T) Mini Repeater, supports 4 UTP ports, 120 VAC external power supply, activity and link LEDs for each port.
LMRxT-02	Same features and price as -01 units, with 220 VAC external power supply option. (non-CE compliant*)

*CE = The European Standardization Certification for Product Safety

Repeaters/Hubs - Thin Coax



Thin coax Ethernet (10BASE2) is a widely used medium that is characterized by its flexible cabling. Coaxial cable lends itself to the addition and subtraction of new devices because of the ease with which new cable runs and taps can be installed. The disadvantages of thin coax are the restrictions to network size and length for the medium: 185 meters in length for a segment and a limit of 30 nodes or connections per segment.

Repeaters, those devices that amplify signals and push them out on other network segments, play a vital role in building large thin coax networks. By providing a means of connecting multiple segments together, thin coax repeaters allow for the construction of networks far surpassing the size and load limits that exist for single 10BASE2 segments. Lantronix LTR8, LTR4 and LTR1 thin coax repeaters are designed to be used as components in the building of such networks.

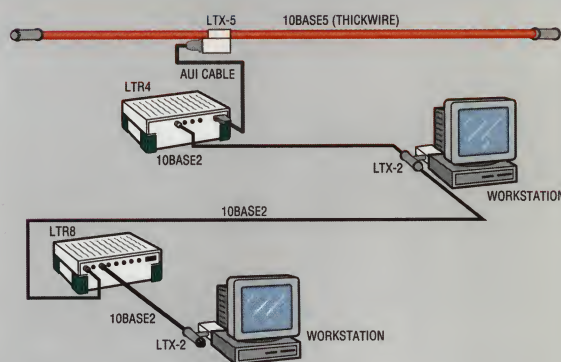
Lantronix LTR series repeaters provide either eight, four or one internally terminated BNC connections for thin coax Ethernet segments. The internal termination allows the network cables radiating from the repeaters to be attached directly into their BNC connectors. This makes them ideal as starting points (hubs) for new network segments.

Another application for the LTR units is an end point of one network segment fanning out to additional segments. An AUI port is also available for network connections, adding a measure of flexibility in applications where LTRx repeaters can be used.

Connections to 10BASE5, 10BASE-T and 10BASE-FL networks are all possible when using the proper transceiver on the AUI port. LTR repeaters are equipped with several features that work to identify and isolate network faults: separate multicolor status and activity LEDs for each individual port; a network collision LED to indicate the extent of collisions; a unit power LED; a reset switch to clear the repeater after a network event or configuration change. Additionally, the LTR repeaters will automatically cease to repeat signals from a segment that is exhibiting abnormal numbers of collisions (partitioning).

All LTR devices come with a 5-year warranty.

Repeater Example



Thin Coax Repeaters/Hubs

PART NO.	DESCRIPTION
LTR8	Thin Coax (10BASE2) Multiport Port Repeater, supports 8 BNC ports and 1 AUI port, internal auto-switching power supply, diagnostic LEDs.
LTR4	Thin Coax (10BASE2) Multiport Repeater, supports 4 BNC ports and 1 AUI port, internal auto-switching power supply, diagnostic LEDs.
LTR1	Thin Coax (10BASE2) Single Port Repeater, supports 1 BNC port and 1 AUI port, internal auto-switching power supply, diagnostic LEDs.

Port Multipliers/ Multiport Transceivers



When building networks, often more than one station needs to be added in an area where only a single network connection is available. In a 10BASE5 Ethernet environment, for example, stations can only be added at 2.5 meter intervals. In 10BASE-T networks, adding an additional station means laying a new twisted pair cable from the wiring closet to the user station. And, the situation for 10BASE2 Thin coax and 10BASE-FL fiber-optic networks is similar.

To add multiple stations to one network connection for all of these media, Lantronix offers its LPM family of port multipliers and multiport transceivers. The LPM family consists of the eight-port LPM8 port multiplier, the LPM4 series of four-port transceivers for 10BASE-T, 10BASE2 and 10BASE5, and the LPM2 series of two-port transceivers for 10BASE-T, 10BASE2 and 10BASE-FL.

Port Multipliers

The LPM8 has one female AUI connector and eight male AUI connectors, each one capable of receiving a transceiver cable from a network device. The LPM8 works somewhat as an Ethernet hub, but it doesn't count as a repeater therefore it can be added to networks without worrying about violating Ethernet's four repeater rule.

Port multipliers can be used to build standalone

networks. The user devices can each be connected to a port on the LPM8 and will be able to communicate with each other without additional hardware. If connection to a network is required at a later date, a connection can be made to the network port enabling the entire workgroup to be added to the network.

Multiport Transceivers

In networks where only one 10BASE-T line has been installed, but multiple users must be connected, the LPM4-T and LPM2-T multiport transceivers each provide either two or four user ports from that UTP cable. For 10BASE2 networks, the LPM4-2 and LPM2-2 each offer a BNC 10BASE2 connector and either four or two AUI connectors for user stations. For multimode 10BASE-FL networks, multiple stations can be added to a single cable using the LPM4-FL and the LPM2-FL four and two port fiber-optic transceivers. All LPM multiport transceivers offer diagnostic LEDs to indicate the transmission of data and the status of the device. Additionally, the 10BASE-T versions have a switch that enables or disables link test, and the 10BASE2 models have a switch that selects whether the unit will inform the attached device of network collisions even if that device is not transmitting. Both models also offer switch selectable heartbeats.

All LPM devices come with a 5-year warranty.

Multiport Transceivers

PART NO.	DESCRIPTION
LPM8-01	Ethernet Port Multiplier, 8 AUI network interface connectors, AUI network interface, diagnostic LEDs, receive and jabber LEDs for each port, 120 VAC external power supply included.
LPM8-02	Same as above with 220 VAC external power supply included.
LPM4-T	Twisted Pair Multiport Transceiver, 10BASE-T, 4 AUI network interface connectors, diagnostic LEDs.
LPM4-2	Thin Coax Multiport Transceiver, 10BASE2, 4 AUI network interface connectors, diagnostic LEDs.
LPM4-FL	Fiber Optic Multiport Transceiver, 10BASE-FL, 4 AUI network interface connectors, diagnostic LEDs, dual ST-style connectors.
LPM2-T	Twisted Pair Multiport Transceiver, 10BASE-T, 2 AUI network interface connectors, diagnostic LEDs.
LPM2-2	Thin Coax Multiport Transceiver, 10BASE2, 2 AUI network interface connectors, diagnostic LEDs.
LPM2-FL	Fiber Optic Multiport Transceiver, 10BASE-FL, 2 AUI network interface connectors, diagnostic LEDs, dual ST-style connectors.

Converters



A common problem for network managers today is incompatibility between networking media. A workstation with only a 10BASE-T port must be connected to a Thickwire backbone, or several file servers on a thin coax Ethernet must be connected via a single twisted pair 10BASE-T cable to a hub. Lantronix provides a solution to these situations with the LTX-C converter product family.

The LTX-C is a converter device with a 10BASE-T RJ45 connector on one end and a female AUI connector on the other. The LTX-C allows you to connect a device using 10BASE-T twisted pair cable to any network transceiver. When combined with the Lantronix LTX-2, LTX-FL or LTX-5 (see configuration options below), the LTX-C allows conversion between 10BASE-T devices and almost any type of 802.3 Ethernet. The LTX-C is not a repeater, so standard Ethernet distance rules apply. Also, it is best to count the LTX-C as half of a repeater when designing your network.

The following are various applications where the LTX-C can be used:

- ▼ A workstation with a single 10BASE-T port that must be connected to a thin coax Ethernet: first connect the LTX-C to the workstation via twisted

pair and then use a thin coax transceiver to connect the LTX-C to the thin coax network.

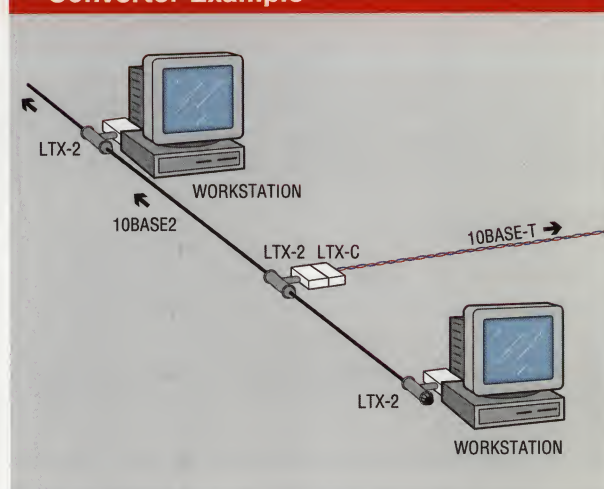
- ▼ A thin coax Ethernet segment containing several nodes that must be connected to a 10BASE-T hub via a single twisted pair cable: the LTX-C can be connected to the hub and then the thin coax segment can be attached to the LTX-C's AUI port using a thin coax transceiver.
- ▼ A file server with a 10BASE-T port that must be connected to a Thickwire network: in this case, the LTX-C plugs directly into the AUI port on the Thickwire transceiver and the server is connected via twisted pair to the LTX-C.

The LTX-C incorporates both a selectable link test and a polarity-sensing function that detects and sometimes corrects cabling problems.

The LTX-C also has seven LEDs for monitoring device status: Power; Transmit Activity; Receive Activity; Collision; Jabber; Polarity; Good Link.

All LTX converters come with a 5-year warranty.

Converter Example



Converters

PART NO.	DESCRIPTION
LTX-C-01	Twisted Pair to AUI Converter, 10BASE-T, AUI network interface connector, diagnostic LEDs, 120 VAC, external power supply included.
LTX-C-02	Same as above with 220 VAC external power supply.
LTX-C2-11	Twisted Pair to Thin Coax Converter, LTX-2 and LTX-C purchased together, 120 VAC, external power supply included.
LTX-C2-12	Same as above with 220 VAC external power supply.
LTX-C5-01	Twisted Pair to Thickwire Converter, LTX-5 and LTX-C purchased together, 120 VAC, external power supply included.
LTX-C5-02	Same as above with 220 VAC external power supply.
LTX-CFL-11	Twisted Pair to Fiber Optic Converter, LTX-FL and LTX-C purchased together, 120 VAC, external power supply included.
LTX-CFL-12	Same as above with 220 VAC external power supply.

Hogeschool Rotterdam en omstr.
InformaticaCentrum
T.a.v. de heer Ing. D.J.C. Marquart
G.J. de Jonghweg 6
3015 GG ROTTERDAM

Amsterdam, 12 augustus 1996
Ref: 96/mai0730/DG/avl

Betreft: Lantronix Ethernet Tutorial & Product Guide

Geachte heer Marquart,

Hierbij zenden wij u de geheel vernieuwde **Lantronix Ethernet Tutorial & Product Guide** met hierin opgenomen de nieuwe Remote Access Servers, Print Servers, RMON Probes en Network Analyzers.

Lantronix staat inmiddels bekend om zijn uitstekende prijs / prestatie verhouding en zijn uitstekende kwaliteit van producten en support.

Om het u gemakkelijk te maken de Remote Access producten van Lantronix binnen uw netwerk op te nemen als b.v. Internet Gateway of als Router om uw externe medewerkers een goed beveiligde toegang te geven op uw netwerk, bieden wij u een **gratis LRS-1** aan. Indien u in de maanden augustus of september een bestelling plaatst voor Lantronix producten met een orderwaarde groter dan f 8.500,-.

Verder willen wij uw speciale aandacht vragen voor de Lantronix **Network Management Tools** zoals de **LRP6 en LRP2 Multiprt RMON Probes**, en de **LNA6 en LNA2 Multiport Network Analyzers**.

Beide producten zijn absoluut uniek in de markt daar zij de mogelijkheid bieden een gesegmenteerd (door middel van Switches/Bridges) Ethernet te kunnen monitoren en managen. Ter introductie bieden wij op beide producten een **introductiekorting van 10%**.

LRP-6	van f 9.164,- voor f 8.247,-	LRP-2	van f 6.414,- voor f 5.772,-
LNA-6	van f 7.331,- voor f 6.598,-	LNA-2	van f 5.498,- voor f 4.948,-

Maak gebruik van dit wel zeer unieke aanbod.

Graag geven wij u nadere inlichtingen over de Lantronix producten.
Wij hopen dat het lezen van de catalogus en de tutorial u inzicht geeft in de producten van Lantronix en u meer duidelijkheid biedt op het gebied van Ethernet netwerken.

Hoogachtend,
HAS Computersystems B.V.



Ethernet Tutorial

LANs

Networks are collections of independent computers that communicate with one another over a shared medium. Local area networks (LANs) are those networks usually confined to a geographic area, such as a single building or a college campus. LANs, however, are not necessarily simple in design, as they may link many hundreds of computers and be used by many thousands of users. The development of various standards for networking protocols and media has made possible the proliferation of LANs in organizations worldwide for business and educational applications.

Ethernet

Ethernet is the most popular LAN technology in use today. Other LAN types include Token Ring, Fast Ethernet, Fiber Distributed Data interface (FDDI) and LocalTalk. Ethernet is popular because it strikes a good balance between speed, cost and ease of installation. These strong points, combined with wide acceptance in the computer marketplace and the ability to support virtually all popular network protocols, makes Ethernet an ideal networking technology for most computer users today.

The Ethernet standard is defined by the Institute for Electrical and Electronic Engineers (IEEE). IEEE Standard 802.3 defines rules for configuring an Ethernet as well as specifying how elements in a network interact with one another. By adhering to the IEEE standard, network equipment and network protocols will operate in the most efficient manner.

Protocols

Network protocols are standards that allow computers to communicate. A protocol defines how computers should identify one another on a network, the form that the data should take in transit, and how this information should be processed once it reaches

its final destination. Protocols also define procedures for handling lost or damaged transmissions or "packets." IPX, TCP/IP, DECnet, AppleTalk and LAT are examples of network protocols.

Although each network protocol is different, they all use the physical cabling in the same manner. This common method of accessing the physical network allows multiple protocols to peacefully coexist, and allows the builder of a network to use common hardware for a variety of protocols. This concept is known as "protocol independence," which means that the physical network doesn't need to concern itself with the protocols being carried.

Media and Topologies

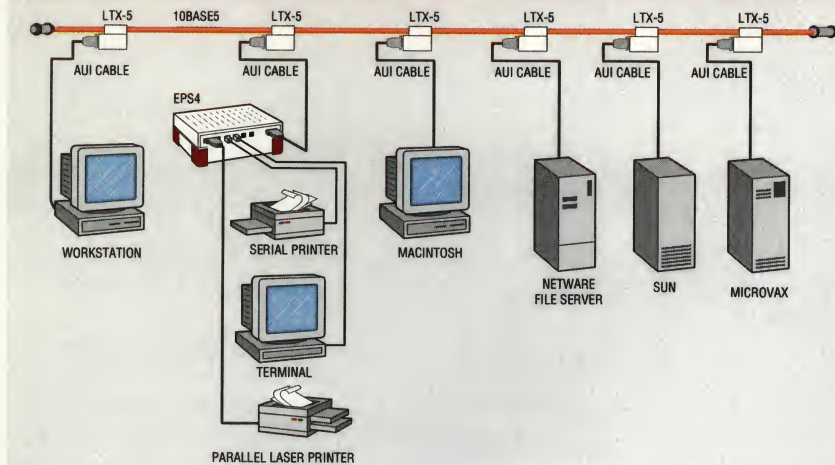
An important part of designing and installing an Ethernet is selecting the appropriate Ethernet medium for the environment at hand. There are four major types of media in use today: Thickwire, thin coax, unshielded twisted pair (UTP) and fiber optic.

Ethernet media are used in two general configurations or topologies; "bus" and "star." These two topologies define how "nodes" are connected to one another. A node is an active device connected to the network, such as a computer, printer or networking equipment like a repeater or a router.

A bus topology consists of nodes connected together in series with each node connected to a long cable or bus. Many nodes can tap into the bus and begin communication with all other nodes on that cable segment. A break anywhere in the cable will usually cause the entire segment to be inoperable until the break is repaired.

A star topology links exactly two nodes together. The primary advantage of this type of network is reliability, for if one of these "point-to-point" segments has a break, it will only affect the two nodes on that link. Other nodes on the network continue to operate as if that segment were nonexistent. Ethernet hubs are

10BASE5 Network Example



used as collection points to allow multiple users to communicate in a star configuration.

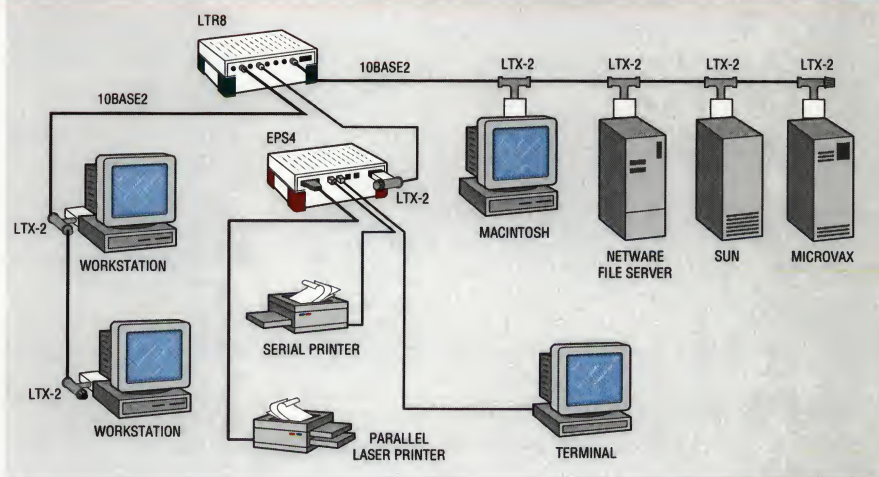
Thickwire

Thickwire, or 10BASE5 Ethernet, is generally used to create large "backbones." A network backbone joins many smaller network segments into one large LAN. Thickwire makes an excellent backbone because it can support many nodes in a bus topology and the segment can be quite long. It can be run from workgroup to workgroup where smaller departmental networks can then be attached to the backbone. A thickwire segment can be up to 500 meters long and have as many as 100 nodes attached. New nodes are connected to the cable by drilling into the media with a device known as a "vampire tap." Nodes must be spaced exactly 2.5 meters apart to prevent signals from interfering with one another.

Thin Coax

Thin coax, or 10BASE2 Ethernet, offers the advantages of thickwire's bus topology with lower cost and easier installation. Thin coaxial cable is more flexible than thickwire, but it can only support 30 nodes per segment, each at least one-half meter apart. Each segment must not be longer than 185 meters. A thin coax segment is actually composed of many lengths of cables, each with a BNC type connector on both ends. Each cable length is connected to the next with a "T" connector wherever a node is needed.

10BASE2 Network Example



Twisted Pair

Unshielded twisted pair, or UTP, cable is similar to telephone cable and comes in a variety of grades, with each higher grade offering better performance. Level 5 cable is the highest, most expensive grade, offering support for transmission rates of up to 100 Megabits per second (Mbps). Level 4 and level 3 cables are less expensive but cannot support the same data throughput speeds; level 4 cable can support speeds of up to 20 Mbps, level 3 up to 16 Mbps. Level 2 and level 1 cables are the lowest grades and are designed primarily for voice and low-speed

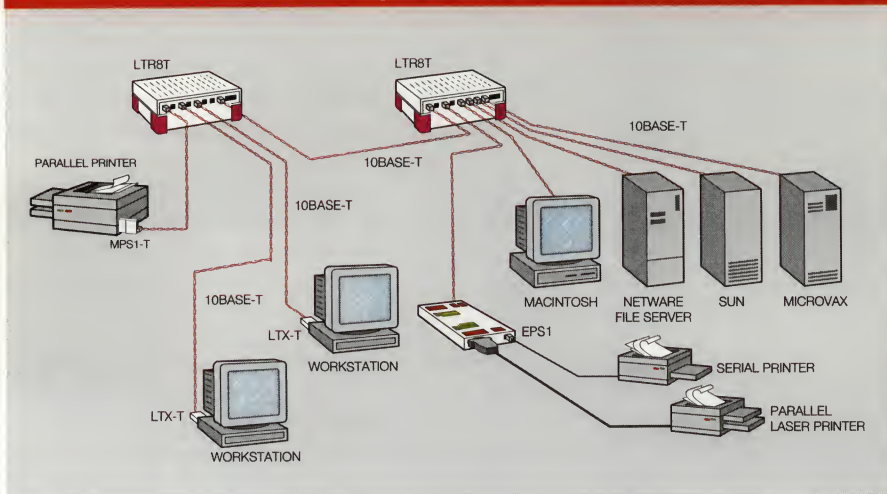
transmissions (less than 5 Mbps); these should not be used in the design of 10BASE-T networks.

A UTP or 10BASE-T Ethernet uses a star topology. Generally a computer is located at one end of the segment, and the other end is terminated in a central location with a hub. Because UTP is often run in conjunction with telephone cabling, this central location can be a telephone closet or other area where it is convenient to connect the UTP segment to a backbone. UTP segments are limited to 100 meters.

Fiber Optic

Fiber-optic, or 10BASE-FL, Ethernet segments are similar to twisted pair. Fiber-optic cable is more expensive, but it is invaluable for situations where electronic emissions and environmental hazards are a concern. The most common situation where these conditions threaten a network is in LAN connections between buildings. Lighting strikes can wreak havoc and easily destroy networking equipment. Fiber-optic

10BASE-T Network Example



cables effectively insulate networking equipment from these conditions because they do not conduct electricity. Fiber-optic cable can also be useful in areas where large amount of electro-magnetic interference is generally present, such as on a factory floor or inside a steel mill.

The Ethernet standard allows for fiber-optic cable segments up to 2 kilometers long. Remote nodes and buildings that are otherwise not reachable with copper media can be connected.

Fast Ethernet

For Ethernet networks that need higher transmission speeds, a new Fast Ethernet standard has been established. The 100BASE-T (IEEE 802.3u) LAN standard raises the Ethernet speed limit from 10 Megabits per second to 100 Megabits per second with only minimal changes to the existing cable structure. There are three types of Fast Ethernet standards; 100BASE-TX for use with level 5 UTP cable, 100BASE-FX for use with fiber-optic cable, and 100BASE-T4 which has an extra two wires for use with level 3 UTP cable. The 100BASE-TX standard has become the most popular due to its close compatibility with the 10BASE-T Ethernet standard.

Network Management

For many years, the Simple Network Management Protocol (SNMP) has been the most popular tool for managing networks. SNMP relies on agents in each device on the network which collect data based on industry standard Management Information Bases (MIBs). An SNMP management station can poll these agents to collect this information and then display it so the network manager can track the events occurring on the network.

In 1991, the Remote Monitoring (RMON) protocol was created to augment SNMP in networks that are segmented by switches or that have many remote

links. RMON uses intelligent agents to provide filtered data and information only when it is required by the SNMP management station. RMON is the perfect complement to SNMP. It reduces the polling that had previously hampered the use of SNMP on larger networks and extends the range of information that can be sent back to the SNMP manager.

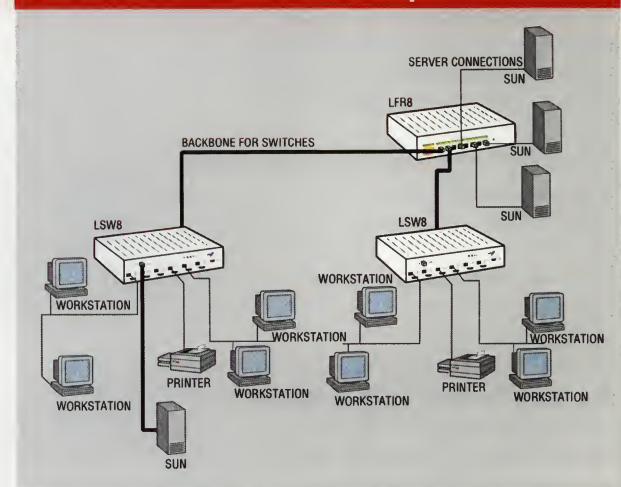
RMON adds nine new MIBs or groups to SNMP that help the network manager track the conversations on a network. With this data, the SNMP management station

can build a chart of these conversations, and a network manager can refer to that chart when planning for network utilization or seeking the source of problems on the network. RMON also enables probes to measure network performance. When the threshold for acceptable network behavior is exceeded, the RMON probe alerts the SNMP management station of the problem. The RMON protocol reports statistics at OSI layer two (the data link layer) although some new extensions now allow the reporting of OSI layer three (the network layer) information. A new RMON standard labeled "RMON II" is currently being approved and will enable RMON probes to completely provide information at OSI layer three.

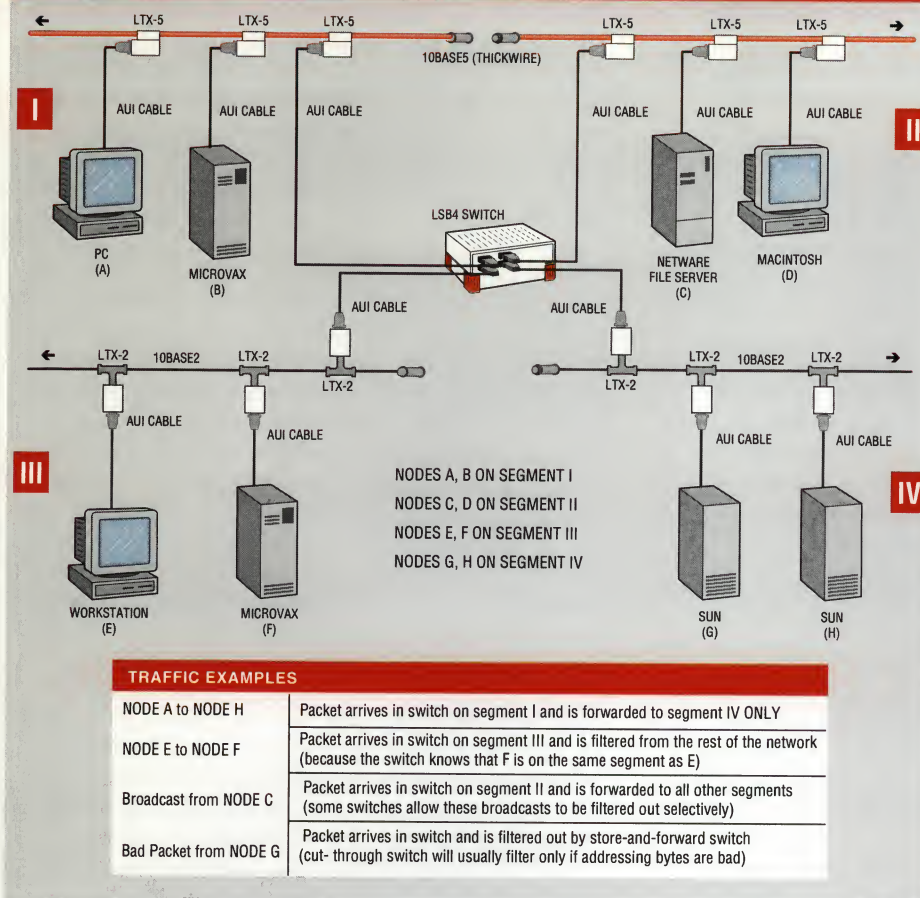
Transceivers

Transceivers are used to connect nodes to the various Ethernet media. Transceivers, also known as Media Attachment Units (MAUs), attach to the Ethernet cable and provide an Application User Interface, or

100BASE-T Network Example



Network Switch Example



AUI, connector for the computer. The AUI connector consists of a 15 pin D-shell type connector, female on the computer side, male on the transceiver side. Many Ethernet compatible computers provide such an AUI connector. The transceiver is generally attached directly to the computer's AUI connector, or the transceiver may be attached to the computer with a specially shielded AUI cable. In addition to an AUI connector, many computers and network interface cards also contain a built-in 10BASE-T or 10BASE2 transceiver, allowing them to be connected directly to Ethernet without requiring an external transceiver.

Repeaters

Repeaters are used to connect two or more Ethernet segments of any media type. As segments exceed their maximum number of nodes or maximum length, signal quality begins to deteriorate. Repeaters provide the signal amplification and retiming required to connect segments. A repeater connection counts in the total node limit on each segment. For example, a thin coax segment may be 185 meters in length and have 29 nodes or stations and one repeater since the total numbers of nodes is 30 per segment. A thickwire segment may be 500 meters in length and have 98

nodes with two repeaters for a total of 100 nodes per segment. Ethernet repeaters are necessary in star topologies. A twisted pair repeater allows several point to point segments to be joined into one network. One end of the point-to-point link is attached to the repeater and the other is attached to the computer with a transceiver. If the repeater is attached to a backbone, then all computers at the end of the twisted pair segments can communicate with all the hosts on the backbone.

Repeaters also monitor all connected segments for basic characteristics necessary for Ethernet to run correctly. A segment can become inoperable if, for example, a break occurs. Repeaters limit the effect of these problems to the faulty segment of cable by disconnecting the problem segment and allowing unaffected segments to function normally.

A network using repeaters is subject to the "5-4-3" rule of repeater placement: the network can only have five segments connected; it can only use four repeaters; and of the five segments, only three can have users attached to them; the other two must be inter-repeater links. These restrictions have to do with the timing constraints of Ethernet. Although electrical signals inside the Ethernet media travel near the speed of light, it still takes a finite time for the signal to travel from one end of a large Ethernet to another. The Ethernet standard assumes it will take roughly 50 microseconds for a signal to reach its destination. If the design of the network violates the 5-4-3 rule, this timing guideline will not be met and the sending station, having not received an acknowledgment of its sent packet, will continue to resend that packet. This can lead to packets being lost, slow network performance and applications that are slow or fail.

Bridges

The function of a bridge is to connect separate Ethernets together. Bridges map the Ethernet addresses of the nodes residing on each network segment and then allow only the necessary traffic to pass through the bridge. When a packet is received by

the bridge, the bridge determines the destination and source segments. If the segments are the same, the packet is dropped ("filtered"); if the segments are different, then the packet is "forwarded" to the right segment. Additionally, bridges prevent all bad or misaligned packets from spreading by not forwarding them. Bridges are called "store-and-forward" devices because they look at the whole Ethernet packet before making their filtering or forwarding decisions.

Many bridges are learning bridges, meaning that they determine on which segment the user is located by building a table as packets are passed through the network. This learning capability raises the possibility of creating network loops in networks that have many bridges. As each device learns the network configuration, a loop would present conflicting information on which segment houses a specific address and force the device to forward all traffic. The Spanning Tree Algorithm is a software device for describing how switches and bridges can communicate to avoid network loops.

Ethernet Switches

Ethernet switches are an expansion of the concepts in Ethernet bridging. If it makes sense to link two networks through a bridge, why not develop a device that can link four, six, 10 or more networks together? That's exactly what a LAN switch does. LAN switches come in two basic architectures, cut-through and store-and-forward.

Cut-through switches have, in the past, held a performance advantage because when a packet comes into the switch, it only examines the destination address before forwarding it on to its destination segment. A store-and-forward switch, on the other hand, accepts and analyzes the entire packet before forwarding it to its destination. It takes more time to examine the entire packet, but it allows the switch to catch certain packet errors and keep them from propagating through the network. Today, the speed of store-and-forward switches has caught up with cut-through switches to the point where the difference between the two is minimal. Also, there are a large number of hybrid switches available that mix both cut-through and store-and-forward architectures.

Each of the segments attached to a switch has a full 10 Mbps of bandwidth shared by fewer users which results in better performance. Newer switches today offer high-speed links, either FDDI, Fast Ethernet or ATM, that can be used to link the switches together or to give added bandwidth to particularly important servers that get a lot of traffic.

Routers

Routers work in a manner similar to switches and bridges in that they filter out network traffic. Rather than doing so by packet addresses they filter by specific protocol. Routers were born out of the

necessity for dividing networks logically instead of physically. An IP router can divide a network into various subnets so that only traffic destined for particular IP addresses can pass between segments. The price paid for this type of intelligent forwarding and filtering is usually calculated in speed of the network. Such filtering takes more time than that exercised in a switch or bridge which only looks at the MAC layer.

Network Analyzers

As networks have become more complicated, the tools for troubleshooting them have developed as well. A network analyzer is a device designed to monitor, capture and analyze network packet traffic on a specified network or network segment. Analyzers allow a network manager to examine actual packet traffic between nodes, which is necessary to solve complex network problems.

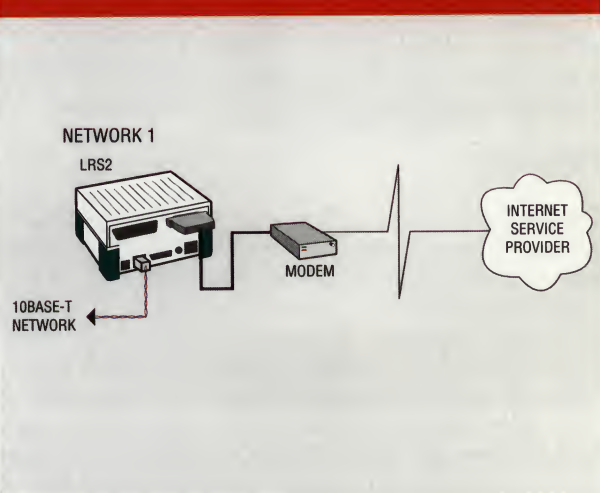
In the past, such products were limited in use to actual protocol developers - ease of use features such as automatic protocol decoding and alarm warnings for critical conditions have made these products more desirable for every network manager.

Remote Access

To meet increasing demand for connectivity of remote offices and remote users with portable PCs, a new breed of products has developed to allow the remote user access to other networks and their resources. In some instances, leased lines can be used to link remote offices with other locations, but this solution is expensive and only makes sense for larger remote offices. Remote access servers provide connection points for both dial-in and dial-out applications on the network to which they are attached.

These hybrid devices are capable of routing and filtering protocols, and offer other services such as

Internet Access with a Remote Server



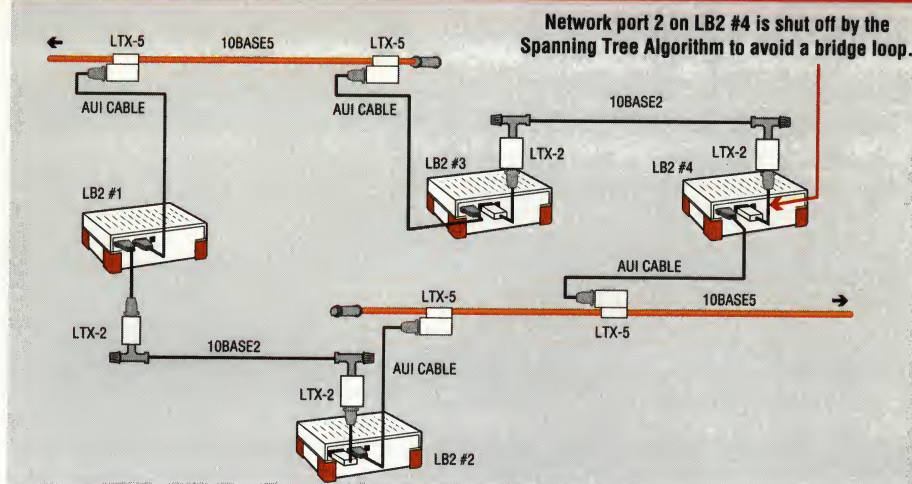
modern pooling and terminal/printer services. Dial-up remote access offers both the remote office and the remote user the economy and flexibility of "pay as you go" telephone services. For the remote PC user, there is the flexibility of connecting from any available telephone jack, be it in a hotel or on an aircraft.

Remote access consists of the following major types of connections: LAN-to-LAN and remote node/remote control. In LAN-to-LAN, one network connects to another via a dial-up link and both share access to resources on either network. Internet access is one type of LAN to LAN application. In remote node/remote control applications, a remote user on a PC or workstation connects to a network and functions as a peer. Dial-up connections normally take place with PPP (Point-to-Point Protocol), which allows for the transport of a number of protocols, or with SLIP (Serial Line Internet Protocol), which transports IP over serial lines. Remote access products also support different types of modems and telephone line standards. The buyer of remote access equipment can choose between ordinary analog/digital phone lines or ISDN depending upon a product's interfaces.

Terminal and Printer Servers

Terminal servers and printer servers support the use of terminals and printers on networks, as well as modems and other serial devices. A server that provides network access to serial devices only is

Spanning Tree Example



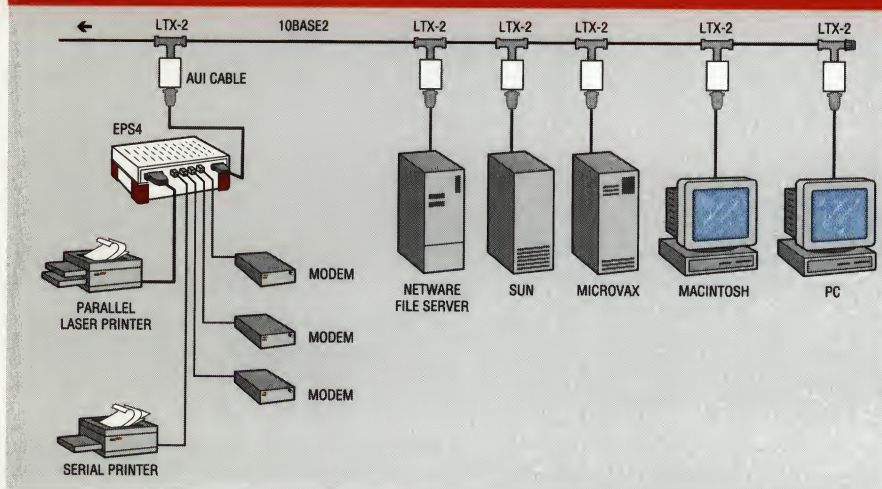
called a "terminal server" in spite of the fact that it can support serial printers as well as serial terminals. A "printer server" is expected to have at least one parallel port, but may also have one or more serial ports. The primary difference between them is that terminal servers are bidirectional devices while printer servers have been unidirectional devices, at least as far as data transmissions are concerned. Even with bidirectional data flow, recently introduced by several printer manufacturers so printers can communicate with a host regarding font availability, the vast majority of the data still will flow in the direction of the printer.

The original role of terminal servers was to enable terminals to transmit data to and receive data from host computers across local area networks, without requiring each terminal to have its own network connection. And while the terminal server's existence is still usually justified by convenience and cost considerations, its inherent intelligence provides many

more advantages. Among these is enhanced remote monitoring and control. Terminal servers that support protocols like SNMP make networks easier to manage. Another advantage comes in local communications, because a terminal server can facilitate communications between the devices that connect to it (the devices in its "domain") without tying up network resources. Being able to broadcast messages to all of these devices is another benefit.

Devices that are attached to a network through a terminal

Sharing Resources with a Printer/Terminal Server



server or a printer server can be shared between terminals and hosts at both the local site and throughout the network. A serial printer, for example, might be accessed by a local host or by a distant one. (In the case of the local host, the transmission won't go beyond the local terminal or printer server.) Similarly, a single terminal may be connected to several hosts at the same time (in multiple concurrent sessions), and switch between them. Workload balancing comes almost automatically as a consequence of having multiple similar resources on the network. A terminal server can locate the least loaded host with a given set of software on the network, or a host's server can find the next available printer at a given site.

With the advent of multiprotocol terminal servers, the problem of a user needing two terminals to reach hosts that used different communications protocols was alleviated. As long as the terminal server supports the protocol used by the host, the terminal attached to that server can access that host as if it were using the terminal's own native protocol.

A similar situation occurs with multiprotocol printer servers. The same printer might be accessed by both Novell and Unix hosts. The print server can simply queue and print each job in the order in which print requests are received, regardless of protocol used.

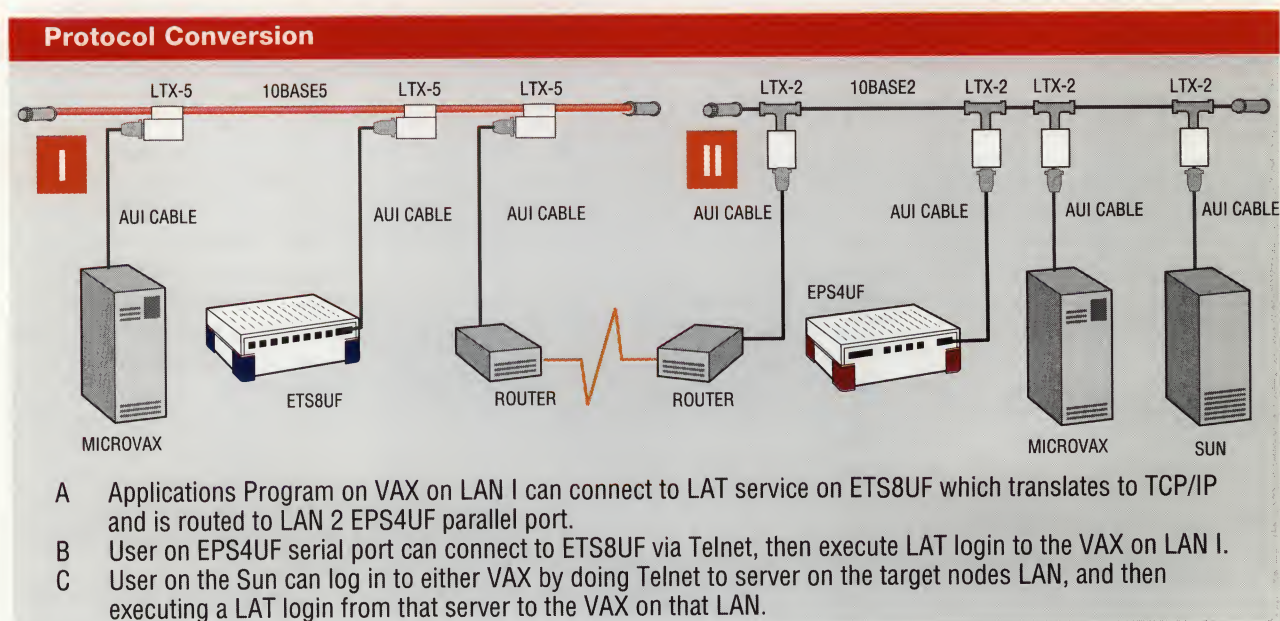
Workstations and terminal servers can make a great combination too, even though workstations don't usually need a server to attach them to a network. The two devices work well together because workstations have plenty of computing power for supporting multiple users and a terminal server can add the multiple connections that allow access to the computer. In this scenario, the terminal server physically connects the terminal devices to the network. The result is the same in providing access to

the workstation. An additional benefit is that the terminals can access other network resources. Economically, it makes sense to have a single connection to the network instead of individual interface cards and transceivers for each terminal.

DEC systems using the LAT protocol and Unix systems using TCP/IP have no natural means to communicate with each other, in spite of how common it is to have VAXes and Sun workstations in the same facility. Given its natural translation ability, a multi-protocol terminal server can perform conversions between the protocols it knows, like LAT and TCP/IP, at least for those which are set up to work with terminals. While terminal server bandwidth isn't adequate for large file transfers, it can easily handle host-to-host inquiry/response applications, electronic mailbox checking, etc. And it is far more economical than the alternatives of acquiring expensive host software of special-purpose converters. Staying flexible: Terminal and print servers give their users great flexibility in configuring and managing their networks. Whether it is moving printers and other peripherals from one network to another, expanding the dimensions of interoperability, or preparing for growth. And you can do it all without major rewiring.

Now What?

We hope this introduction to Local Area Networks has been helpful and informative. Unfortunately we cannot explain everything there is to know about planning, installing, administering and troubleshooting a LAN in a few or even a hundred pages. Many books and magazines exist that explain all aspects of computer networks, from LANs to WANs, from network applications, to running cable. Check your local bookstore, software retailer or newsstand.



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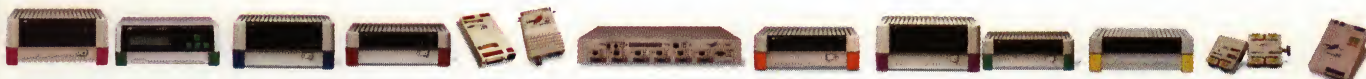


- ▼ EPS2/EPS1, MPS1 Ethernet Print Servers
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LANTRONIX®

15353 Barranca Parkway
Irvine CA 92718
714/453-3990 Fax: 714/453-3995
sales@lantronix.com
International Sales: 714/450-7227
intsales@lantronix.com
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15353 Barranca Parkway, Irvine California 92718-2216 ▼ 714/453-3990 ▼ FAX 714/453-3995
North American Sales 800/422-7055 ▼ North American Sales Fax: 714/450-7232 ▼ sales@lantronix.com
International Sales 714/450-7227 ▼ International Fax 714/450-7231 ▼ intsales@lantronix.com
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